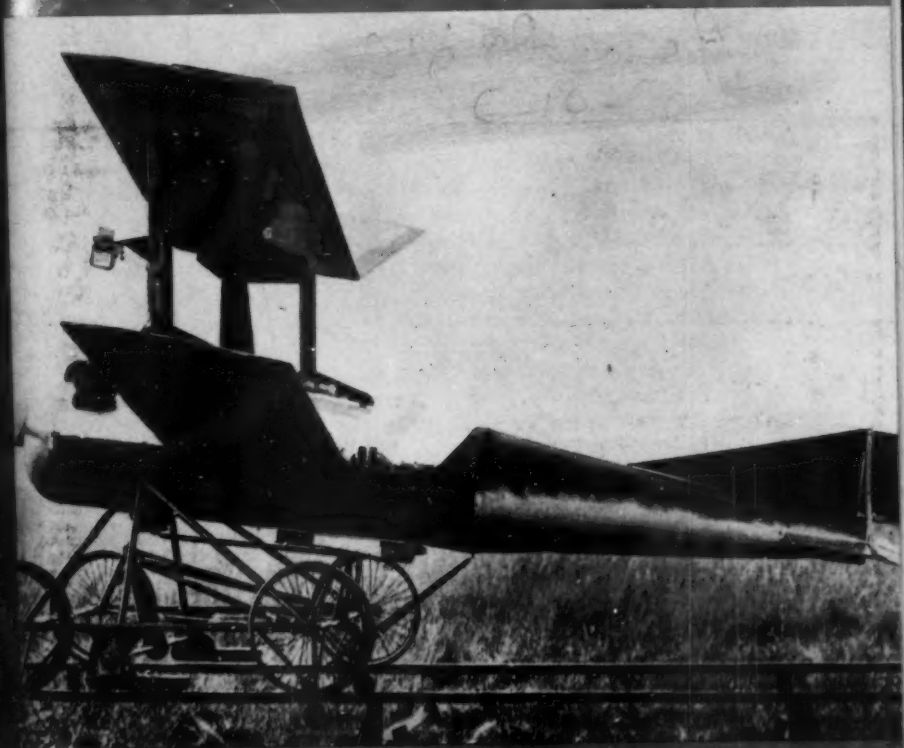
THE AIR POWER HISTORIAN



Credit: Air Force Photo

The Bug of 1917
First American Pilotless Bomber

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THE AIR FORCE HISTORICAL FOUNDATION

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Credit: U. S. ARMY

As The Air Power Historian *was going to press, the U. S. Army succeeded in placing in orbit this country's first earth satellite, fittingly dubbed "The Explorer." The above photo shows the Jupiter C at Cape Canaveral, Florida, seconds after the firing which took place at 10:48:07 P.M., Friday, January 31.*

HOW WE FELL BEHIND *in Guided Missiles*

By TREVOR GARDNER

The Honorable Trevor Gardner was Assistant Secretary of the Air Force for Research and Development in 1953-1955. He is now President of the Hycon Engineering Company. The editors are pleased to present this article by Mr. Gardner, whose views on missile development speak with the authority of his experience.

It was not until German V-1's and V-2's began to rain their explosive violence on the British Isles near the close of World War II that the United States and the American people experienced their first awareness that guided missiles were an important, and possibly decisive, instrument for the wars of the future. From that (for us) essentially painless introduction, understanding of the military implications of this category of weapons has progressed to a point where the public, as well as defense planners and strategists, accept intermediate-range ballistic missiles (IRBM's), intercontinental ballistic missiles (ICBM's), and even space satellites as fundamental instruments of national policy—key pieces in the international chess game which is being played out so relentlessly and so fatefully between the United States and its allies on the one hand and the Soviet Union and its minions on the other.

The national guided missile program, and particularly that phase of it entrusted to the U. S. Air Force, has become the subject of continued notice and comment in the press and so a matter of daily interest and concern to every John and Jane Doe in the land. Awesomely fantastic devices, which seem more properly to belong to the pages of science fiction, are pressing topics of debate in the halls and committee rooms of the Congress. Indeed, it seems certain that the progress and management of the missile development program will rank as a primary issue in the forthcoming contest between the political parties. On all sides, the man in the street is besieged by charges, promises, countercharges, and counter-promises, so that he scarcely knows whom or what to believe.

The truth concerning the exact posture of the United States in the missile art as compared to that of Soviet Rus-

sia has been obscured in the avalanche of commentary, even of propaganda, on the subject. The wealth of misinformation available to critics of the missile program, the lack of candor of certain members of the Administration in describing the state of the program to the nation, and the artificial as well as genuine security limitations surrounding the discussion, have all contributed to the confusion. It is against this background, where the atmosphere is alternately charged with alarm or suffused by apathy, where scientific fact, intense emotions, and political interest are crazily intermingled, that this brief article must attempt to segregate the Air Force missile program from the effort of the other Services and, isolating it, try to evaluate its history and to speculate a little on its future.

Scholars encourage us to study history as a means of gaining some understanding of the present and, possibly, of predicting the future. Whether, in the missile field, this can be a profitable exercise is a moot question, since missile history prior to 1953 does not bear very heavily on the military-political dilemma which faces the country in the post-Sputnik era. Nonetheless, there may be some lessons to be learned.

The business of the U. S. Air Force and of its predecessor organizations is and always has been to carry out military missions in and through the air, applying to its uses the various arts and sciences which relate to overcoming or circumventing the laws of gravity. Like the airplane, the missile is an air vehicle, and the interest of the Air Force in developing missiles with which to execute its missions is a logical expansion of a historical as well as a technological process. The Air Force appears to have realized the mandatory nature of this extension, and since early 1954 has pressed forward with the development of all of its missiles, particularly ballistic missiles, with full perception of the fact that it was engaging thereby in the forging of new basic instruments of national policy.

In the period extending from the first quarter of 1954 to November 1957 (that is, to the advent of Sputnik II), giant strides were made by the Air Force in developing its missile program. These advances were accomplished in spite of a basic internal (built-in) conflict between missiles and manned aircraft, in spite of the confused organization which has existed in the Pentagon for administering the missile program, and in spite of the vast duplication of effort which has characterized the entire national missile picture. Nevertheless, Sputniks I and II found the Air Force essentially without a program capable of meeting the challenge for the control of space, toward which the Soviet rival has chalked up the first success. Perhaps more immediately painful, the Air Force faced the dawn of the space age in the unfortunate position of appearing to the public, to the other services, and to itself, as technologically less-than-best in the race for IRBM's, ICBM's, satellites, and anti-ballistic-missile missiles.

Before World War II

The history of Air Force missile activities may be conveniently divided into five periods: before World War II, World War II, after World War II to 1954, 1954 to the coming of Sputnik, and post-Sputnik.

The earliest history (or pre-history) of guided missiles might might easily be classed with such technological visions as Jules Verne's conception of the submarine in his fantasy, *Twenty*

Thousand Leagues Under the Sea. It is also probably true—regrettably so—that an informed U. S. citizen's recollections of this pioneer period, especially his evaluation of where the credits belong, would differ materially from those of his counterpart in the U. S. S. R.

In the military field, in the U. S., there was an early development that should command our attention, if only because of what others, not we, later made of the idea. In 1918, at McCook Field, Dayton, Ohio, a group of air enthusiasts, including Orville Wright, Charles F. Kettering, and the late General of the Air Force H. H. Arnold, developed and successfully tested the world's first guided missile, the so-called "Bug" or flying torpedo. This device was a small biplane powered by a 2-cycle 40 hp engine and equipped with a guidance system employing a gyro and supersensitive aneroid barometer. It was launched from a wheeled undercarriage which ran on a portable track—a system not unlike that used by the German pilotless aircraft a generation later. The weight of the "Bug" unloaded was 300 pounds and it carried as its warhead another 300 pounds of T.N.T. The service model of this handy little weapon was in production when the Armistice was signed.

In the field of modern rocketry, no American will dispute the right of Dr. Robert H. Goddard to the title of "father" of this new science, new branch of engineering, and new industry. Certainly, missile history before World War I is dominated by his work. As early as 1909, Goddard conceived the idea of using hydrogen and oxygen as fuels for interplanetary rockets and later extended this idea to the multiple or step-rocket principle. By 1914, Goddard had begun limited experiments with various types of rockets of his own construction, and his first report of progress was published by the Smithsonian Institution in 1919. The first flight of a rocket using liquid propellants was achieved by Goddard on March 16, 1926, at Auburn, Massachusetts. German rocket engineers followed Dr. Goddard's work very closely, from his first publication in 1919 to his death in 1945, and it was Goddard's basic technology which was put to use by the Germans in their crash development of the V-2.

Why, one asks, should the V-2 have been a German development when rockets of this type were within the grasp of scientists in the United States long before the Germans used them? To answer, it would be necessary to write a great deal concerning the trials and tribulations of a great nation stumbling and fumbling to produce inadequate results with inadequate support depending upon inadequate interest. The fact is that, except to a very limited few, none of the experiments of this early technology, even the experiments of Goddard, carried any real implication of the potentialities of the missile art in warfare. Perhaps the most productive interval was that just before World War II when, principally through the efforts of Dr. Theodore von Kármán and a team of scientists at the California Institute of Technology, substantial strides were made in the development and testing of solid-propellant rockets and large gyro-controlled, pump-operated, liquid-fuel rockets.

World War II

Notwithstanding all that had gone before, the United States entered World War II approximately ten to fifteen years behind the Germans in missile technology. Though the war provided new impetus to the search for

militarily useful missiles, neither the AAF nor the other services made significant progress toward developing such unconventional weapons. At the same time, the United States and its Allies, including, notably the Soviet Union, garnered considerable knowledge concerning operational military weapons in the field of rockets. The experiments which the Air Force conducted with guided missiles during World War II may be grouped into four general categories:

1. Conventionally-powered airplanes loaded with explosives and remotely controlled onto a target. Essentially a continuation of suspended World War I experiments ("The Bug," for example), this line of investigation led to the "Weary Willie" and other projects in which B-17's and B-24's were loaded with explosives and remotely directed by manned sister aircraft against objectives in Germany. Excessive vulnerability, poor accuracy, and over-all difficulty caused the early abandonment of this method after not-too-impressive results.

2. Glide bombs or glide torpedoes. Air-launched close to the target and guided in by light- or radar-seeking devices, these bombs were designated GB's (for glide bomb) and were serialized GB-1 through GB-14. Militarily, they were not especially effective but the experiment served to introduce the Air Force to the complexities of employing television, radio, radar, and heat radiation as a source of guidance.

3. Air-launched missiles of conventional-bomb design, controlled in range and/or azimuth from the launching aircraft or by self-contained guidance systems. The National Defense Research Council (NDRC), working with the Air Force, developed the Azon (controllable in azimuth), Razon (controllable in range), and Tarzon (controllable in both azimuth and range) techniques. A few weapons so equipped found their way to the China-Burma-India Theater and were used with some success, but they were never more than marginally better than their non-guided counterparts and were considerably less reliable. Quite justifiably, their military worth was questioned by the operating personnel who bore the specific personal risk involved in delivering these devices over a target.

4. Missile developments stimulated by the German V-1 pilotless aircraft or buzz bomb and by the German V-2 ballistic missile. None of these developments was ever used in combat. The AAF missile, the JB-2, was essentially a copy of the V-1, with minor improvements in speed, range, and guidance. The JB-2 went into production in 1945 but, it should be repeated, was never employed operationally.

In the ballistic missile area, there were a number of developments during World War II which have a direct bearing on the present state of ballistic missile progress. The Air Force (then still the AAF) and the Navy, striving to catch up with German technology, sponsored the establishment of industrial teams to work on particular developmental problems. Conformable to the traditional American way of doing things, the first industrial activity in the missile-production field was a new corporation, set up expressly to tackle what was essentially a new problem. In 1941, almost at the same moment though at opposite ends of the country, two such small companies came into being. They were Reaction Motors, Inc., of Denville, New Jersey, and the Aerojet General Corporation, of Pasadena, California. Both organizations concentrated on the propulsion aspects of the missile art and began the development of facilities.

The Aerojet Corporation, later purchased by the General Tire and Rubber Company, was formed to exploit the unusual know-how of a group of California Institute of Technology scientists and experimentalists who had been associated with the Guggenheim Aeronautical Laboratory and the Jet Propulsion Laboratory. Dr. Theodore von Kármán was the technical and spiritual leader of this group which quickly became enmeshed in projects related to assisted takeoff in the solid-propellant field and to liquid jet-assist packages and liquid rockets in the liquid-propellant field. By the end of the war, both corporations had grown into substantial industrial entities, with considerable accumulated know-how and momentum.

By 1945, some of the existing large industrial companies—notably North American Aviation, Bell Aircraft, General Electric, and Consolidated-Vultee (now Convair, a division of General Dynamics)—had formed missile sections or divisions which were continued in one form or another after hostilities had ceased. In the aggregate, all these efforts represented a fairly heavy investment of money and talent in a broad American missile program, but the fact remains that the United States was still essentially ten to twelve years behind the Germans at the close of World War II.

The case of Germany merits particular mention, by way of contrast. Having entered the war with at least a decade's lead over the Allies in guided missile technology, the Germans early decided to take a major gamble with their national resources by embarking on the V-2 project. By 1942, the research center at Peenemunde had successfully tested a 250-mile missile. Between that date and the end of the war, 6,000 of these missiles were built, and between September 1944 and VE Day about 3,400 were fired operationally. The British Isles were the target for 1,115 V-2's (sometimes referred to, popularly but erroneously, as *Vergeltungswaffen* or retaliation weapons), while 1,675 fell on objectives on the Continent. These missiles, which had been developed on a crash basis, were admittedly inaccurate and unreliable by today's standards, but there is little doubt that, had Germany succeeded as well in its atomic energy program as in its rocket research, V-2's with nuclear warheads would have turned the tide in Hitler's favor.

World War II to 1954

After the collapse of Germany in the spring of 1945, both the United States and the U. S. S. R. had essentially equal access to the substantial body of ballistic missile technology accumulated by the Peenemunde rocket research center, the site of which had been overrun by the Red Army and inspected by American Air Force personnel in the late summer of 1944. Project Paper Clip was initiated by the Air Force to bring to this country as many German rocket scientists as possible and as much of their technology and hardware as could be salvaged. Just what proportion of the German missile brains was gathered by the United States and what by the Soviet Union remains something of a mystery. Certainly the Russians appear to have acquired most of the hardware and the research and production facilities as well as a very substantial segment of the key intellects who had guided the German program.

Of the crop of German scientists imported by Operation Paper Clip, the cream was concentrated at Redstone Arsenal and has served as the core around which the Army's Ballistic Missile Development Center has been

built. With a program of extending and improving the old V-2 technology, it is this group which has developed the 150/250-mile Army-sponsored missile known as the Redstone, which is designed to carry a nuclear warhead. Concurrently, the Redstone group, particularly in the person of Prof. Wernher von Braun, has been the leading voice in the United States for such advanced space projects as earth satellites, moon rockets, and space stations.

Since World War II, the Air Force and its sister services have become increasingly interested in all phases of missile development, both for support of their currently assigned roles and missions and for the roles and missions which they expect the future may have in store for them. It is significant that in the period from mid-1945 to late 1953 the three services started 114 separate missile projects, of which, by the end of 1953, only 25 survived as hardware projects and 9 as study projects. Since that time, additional projects have been initiated and terminated, so that the box score today is roughly 140 projects begun since World War II, with some 40 still in existence. (Depending on what is meant by the term guided missile, certain marginal developments might be added or subtracted which would change this total slightly.)

The period 1945-1954 was one of major change for the Air Force. Some of the changes helped and some hindered the development of guided missiles but, by the end of 1953, the Air Force had 7 official missile projects under way, with about an equal number of study projects.

The first crisis facing the Air Force at the close of World War II was the ruthless demobilization which reduced it from the greatest air force in the world almost to its old status as just another corps of the Army. Next was the unification struggle of 1947 from which it emerged as a full-fledged separate military service but tied in triple harness to the peculiar concept of "balanced forces" and of policies geared to service, rather than to national, roles and missions. Concurrently, it was in a gruelling fight with budgets and how-many-wing programs and weapons systems to rebuild its combat echelons, particularly the Strategic Air Command, into a jet-atomic shield for the Free World.

Air Force interest in missiles was continuous but, by reason of budgetary limitations, erratic in this period. For example, the leaders of the Air Force recognized early in 1946 that certain basic research tools were needed in order to assure rapid technological progress in the new jet era. Missiles, while they seemed like something on the distant horizon of the future, were recognized as an area in which the Air Force had to make progress, capitalizing as much as possible on the seized technology of the Germans. For maximum efficiency and coordination, the Air Force decided on a service-industry-team approach and a number of contracts for missile-type air weapons were negotiated in 1946 and 1947. The principal contract was with Convair for the MX-774, a test vehicle and forerunner of the present Atlas missile. Another contract, with North American Aviation, calling for the development and test firing of large liquid-propellant rocket engines, was the first important step toward the comprehension of the phenomena relating to engines of higher thrust than those which powered the German V-2's.

The bulk of the work in missile propulsion was carried on by the industrial

complex inherited from the war, with the addition of such companies as Marquardt Aircraft, Curtiss-Wright, and Pratt and Whitney. Unfortunately, missile development work within the Air Force was brought to a virtual standstill by the sweeping economy drive launched in 1949 by Secretary of Defense Louis A. Johnson, and the research field that was hit the hardest was the most important one—ballistic missiles. With the Korean War budget of 1950 the trend was reversed for most projects and the Air Force obtained additional funds for research and development in guided missiles. Nevertheless, it was not until 1954 that any major emphasis was given to the ballistic missile program. And it was fiscal 1956 before research and development expenditures for guided missiles equalled, for the first time, those for aircraft. Some idea of the magnitude of the increase can be gained from the fact that, whereas 4% of the money for aircraft and related procurement went for guided missiles in 1952, 12% was allocated to missile purposes in 1956.

By the end of 1953, the Air Force missile development program had produced prototype hardware and, in some cases, production hardware on which further progress could be made only by the expenditure of large additional sums. The situation was complicated by the fact that the Air Force jet aircraft program had arrived at an identical stage of progress at the very same time. Faced with hard decisions affecting the future of both programs, the Air Force was thereupon confronted by a new Administration and a new Congress both determined to effect major economies. To compound the issue still further, the Joint Secretaries and a special civilian committee were reexamining the Air Force missile program with the announced purpose of eliminating overlapping and duplication and reducing the over-all missile development and production expenditures of the various services. At this critical juncture, the Air Force, not unnaturally, reacted to protect its newly-achieved manned jet combat units and, for the time being, re-programmed funds away from the debated missile area into the jet aircraft program.

1954 to Sputnik

The Department of Defense Guided Missiles Study Group of the Armed Forces Policy Council began its review of the missile program of the whole defense establishment in the middle of 1953 and completed its report in the first quarter of 1954. The Group had been given a general directive to reduce the cost of the missile program. It was approaching its task in that spirit when it became aware that an important technological breakthrough had occurred. It realized that that breakthrough had to be evaluated accurately and presented to the Armed Forces Policy Council strictly for what it was worth to the nation's security and regardless of the budgetary consequences. The Group saw that it would very probably be forced to recommend a dramatic increase in the ballistic missile program rather than a reduction of costs in the over-all missile program. Accordingly, a sub-committee, known as the Teapot Committee, was formed (its exact title was the Air Force Strategic Missiles Evaluation Committee). It was composed of some of the nation's most outstanding scientists and engineers and was chairmaned by the late Professor John von Neumann, then of the Institute for Advanced Study, at Princeton, and later a member of the Atomic Energy Commission. Under the leadership of Dr. von Neumann, the Teapot Com-

mittee* began to function in an atmosphere of urgency and excitement. It was given access to the best physical, chemical, and mathematical brains in the country. The Ramo-Wooldridge Corporation was retained to function as a group of technical assistants fully available at all times. Other organizations, like the Rand Corporation, were similarly drafted to assist the Committee in its deliberations.

The technological breakthrough was the thermonuclear breakthrough of 1952-1953, which proved that high-yield, low-weight, reliable small warheads could be developed which, when married to ballistic missiles, could provide a weapon essentially invulnerable and perhaps decisive in its effect if it could be given intercontinental range (5,500 to 6,000 miles). The Teapot Committee analyzed such critical questions affecting the feasibility of an intercontinental ballistic missile as propulsion, structures, guidance systems, and the problems of re-entry. It concluded that an ICBM was not only possible but could be achieved within a reasonably short period of time, provided that the project was given the highest priority and was supported by the practically unlimited funds that would doubtless be needed.

The dramatic conclusions of the Teapot Committee regarding the possibilities of the ICBM and the IRBM altered the whole concept of the role of the guided missile in war. Here, clearly, was a new instrument of nationally policy which now could be forged, provided the Air Force and, more particularly, the Department of Defense would accept the challenge, reverse the essentially negative climate then prevailing, and act in a bold and decisive manner.

The Teapot Committee conclusions were quickly endorsed by General Nathan F. Twining, Chief of Staff of the Air Force, and by Secretary of the Air Force Harold E. Talbott who succeeded, in spite of budgetary and other obstacles, in obtaining funds to launch the program. Formally approving the Teapot recommendations in May 1954, the Air Force issued directives assigning to the ballistic missile program the highest priority and declaring that it was to be accelerated to the maximum extent that technology would permit. In August 1954, the Western Development Division (now the Air Force Ballistic Missile Division) was established at Inglewood, California, to carry out these directives, and Major General Bernard A. Schriever was assigned to command the project. Also, an unusual engineering contract was negotiated with the Ramo-Wooldridge Corporation making it the technical brains of the WDD headquarters, and an organization and program were initiated along the lines of the famous Manhattan District operation of World War II days.

Under this plan, each component of the ICBM was placed in parallel procurement with industry, both for development and production. The result is that today there are two ICBM's under development for the Air Force, the components for each being drawn from one of the parallel component suppliers. These missiles are the Air Force Titan, for which the Martin Company is responsible, and the Air Force Atlas, which is assigned to Con-

* The other members of the Teapot Committee were: Prof. Clark B. Millikan, Cal Tech; Prof. Charles C. Lauritsen, Cal Tech; Dr. Louis G. Dunn, Cal Tech; Dr. Hendrik W. Bode, Bell Tel Labs; Dr. Allen E. Puckett, Hughes Aircraft Co; Dr. George B. Kistiakowsky, Harvard; Prof. J. B. Wiesner, MIT; Mr. Lawrence A. Hyland, Bendix Aviation; Dr. Simon Ramo, R-W Corp; and Dr. Dean Wooldridge, R-W Corp.

vair, San Diego. This Manhattan District approach produced the first successful firing of an ICBM, an event which took place on December 17, 1957, the fifty-fourth anniversary of the first airplane flight of the Wright brothers, and was to all intents and purposes within the schedule of technical possibility originally laid down in early 1954 by the Teapot Committee.

The idea of parallel development and production has its doubtful as well as its helpful side. About the middle of 1955, Secretary of Defense Charles E. Wilson directed that the Air Force Thor IRBM development be paralleled by the Army Jupiter development. In doing so, he ruled that the question of roles and missions, which such a parallel development inevitably raised, would be left to be solved later, and by this means created a further occasion for competition among the services for funds, facilities, and personnel. Whether or not Mr. Wilson's decision has accelerated or retarded the Air Force ballistic missile program is not yet clear, but it is perfectly clear that the decision has been costly and probably actually wasteful. It was the Secretary's conviction that competition in missiles was as desirable and necessary as it was in the automotive industry and that, in a society such as ours, would have the effect of causing an earlier operational capability of an IRBM than might otherwise be achieved.

At about the same time, evidence began to pile up in the United States that our only real competitor, the Soviet Union, had stolen a march on us and appeared to be as much as two years ahead of us in the ballistic missile field. This information had an immediate and drastic impact on the Air Force missile program and, within the Air Force, every effort was made to streamline administrative procedures and speed executive decisions so as to bring the ICBM and IRBM development projects to the point of production. The news about Russia also had its effect elsewhere. The Air Force ICBM program, which had received highest Air Force priority from the Chief of Staff in May 1954, was now given highest national priority by the President. However, by mid-1956, this decision had become diluted, so that, despite the terminological contradiction, this highest priority granted to the Air Force ICBM was being shared with the Air Force IRBM, the Army IRBM, and several other related and supporting programs. Moreover, in spite of continuing disturbing information concerning the U. S. S. R., Secretary Wilson inexplicably issued instructions which tended to slow down the entire ballistic missile program. It is these actions (or inactions), followed so promptly by the nemesis of Sputniks I and II, that have created the national missile crisis and occasioned the national debate which is now in progress.

The Post-Sputnik Period

Sputnik I, with all that it implied concerning Russian technological advancement in missiles as in other arts, was bad news for the confused and beleaguered military and civilian staffs of the Air Force who were at the time necessarily, if regretfully, engaged in preparing stretch-out, budget-paring, and other forms of economy plans. The real problem—how to maintain technical superiority over the U. S. S. R.—had unfortunately been sidetracked in favor of balancing the budget. The bad news of Sputnik I was exceeded only by the extremely bad news of Sputnik II, with its further implications about Soviet capabilities. Clearly, if our national preoccupation with

budget-balancing was producing anything, it was rapidly developing the world's second-best air force and second-best missile effort and, if persevered in, might finally turn the United States into a second-rate military power and, thereby, into a second-class nation.

Before Sputnik, while its ICBM and IRBM development programs were proceeding rapidly in spite of obstacles, there were in the Air Force no forward-looking plans for continuing the conquest of the air ocean above 100,000 feet and into outer space. Programs envisioning scientific and military satellites, manned space vehicles, and the space development centers in which to research them, had all been piled in a corner awaiting attention at some future time unspecified. Since Sputnik II, the Air Force has been trying to evolve plans for conquering outer space and for managing such a program. Significantly, the other services have been similarly engaged. At this moment, no determination has been made and no budget has been generated to support the needs of the Air Force in this area.

The Air Force, in post-Sputnik days, has been occupied also with starting an anti-ballistic-missile hardware program. Quite recently, the Air Force has been assigned the detection and communication phase of the anti-ballistic-missile problem, while to the Army has been assigned the missile which is to be used in conjunction with this ground environment to accomplish the destruction of incoming ballistic missiles in the future.

Deficiencies in the AF Missile Program

As it stands today, there are four major deficiencies in the missile program of the Air Force.

First, there is a lack of forward-looking thought and planning for the conquest and control of outer space. The Air Force badly needs a military reconnaissance satellite, placed in orbit at the earliest possible moment. It further needs to place in orbit a variety of scientific satellites to gain data for the support of its space development program and for meteorological and communications purposes.

Second, the Air Force urgently needs to define, cost out, and procure funds for a space development center which will house the tools needed to support research and development in the first ten years of the post-Sputnik space era. Such a center would include, among other things, elaborate radio astronomy facilities, experimental satellite-tracking equipment, an experimental ICBM launching site, an experimental IRBM launching site, facilities to support research on controlled nuclear and thermonuclear reactions for propulsion purposes, facilities to simulate at sea level conditions of outer space up to 500 miles, facilities for adequate research on human reactions to the conditions of space flight, facilities for simulating and generating high-velocity phenomena (Mach 20 to 30), and facilities for generating extremely high temperatures (solar furnaces, etc.). The facilities of a major development center of this kind would approximate the facilities which are now used at the Wright Air Development Center, at Langley, at Tullahoma, and at Eglin in support of manned aircraft flight.

The third deficiency is the lack of an anti-ballistic-missile missile, most urgently needed. While it is understood that this program is well under way and will be adequately funded, no hardware exists today and there appears to be no likelihood that the United States can have a capability in

this line in the near future. This program must be assigned an extremely high priority, along with the DEW Line and the SAGE System.

The final deficiency is the lack of a bomber-defense missile. The strength of the United States now and in the foreseeable future is highly dependent upon the retaliatory ability of our bomber force. The highest possible interim priority should be placed on the early attainment of a bomber-defense missile compatible with the B-52 aircraft. Every month that passes makes less probable the chances of survival of counterattacking manned bombers. This growing danger must be offset by the earliest possible provision of additional power to penetrate already-alerted enemy defenses.

Conclusion

The Air Force today is at the crossroads between two necessities—the necessity of adopting missiles as its major weapons for the future, and the necessity of continuing with manned aircraft as its principal instruments for achieving military objectives in the immediate present. The principal missions of the Air Force are gradually being redefined, more by the dictate of the times than by decision of the Joint Chiefs of Staff. These missions appear to be: (1) the counter-attack implicit in the doctrine of massive deterrence; (2) the defense of the continental United States from surprise attack, and (3) the preservation of our overseas alliances. Other missions of the Air Force remain important, to be sure, but they are becoming more and more subsidiary in nature.

Having arrived at this crossroads, the Air Force is obliged to move forward on several necessary but unpleasant assumptions which have their greatest clarity when expressed in budgetary terms. First, it must assume that missile expenditures will very soon equal, if not exceed, expenditures for manned aircraft. At the same time, it is obvious that expenditures for manned aircraft cannot be decreased in the foreseeable future. The second assumption is, therefore, that all missile expenditures, however high, are additive. The third assumption is that the United States must conquer outer space, and that the Air Force must fight for funds to support not only its missile programs on top of its manned aircraft requirements but also that additional and costly objective, the conquest of outer space.

The sum of these assumptions, which are in fact vital necessities, equals a vastly expanded Air Force budget, for only dollars and the sense of urgency which the spending of dollars betokens can regain for the Air Force and for the nation the technological leadership of the world in air-missile power.

Air Force Testimonial:

"Only the Air Force, among our military services, has geared its planning and program to take full advantage of nuclear weapons.

"Our airmen have married past facts with future posibilities. . . .

"Our airmen know the nuclear bombings of Hiroshima and Nagasaki effectively hastened the end of World War II. And the Strategic Air Command stands ever ready for *retaliation* in case our country should suffer a heavy attack.

"Our vigorous work on intercontinental ballistic missiles, moreover, gives us fair assurance that the Air Force will be strong in the weapons of the future as well as in the weapons of the present."

—Quotation from *This Week Magazine*, October 13, 1957, in an article by Dr. Edward Teller, entitled "We Must Win the H-War Before It Starts."

Credit: AIR FORCE PHOTO

In the chronological development of rockets and guided missiles the Martin Matador, B-61, became the first operational missile. It is currently deployed at operationally-ready sites in

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AT THE DAWN *of the Space Age*

By GENERAL THOMAS D. WHITE

The following is from an address by the Chief of Staff, U. S. Air Force, to the National Press Club, Washington, D. C., 29 November 1957.

Whether or not the United States possesses adequate airpower . . . how we compare with the communist opposition at any point in time . . . is not solely a matter of military decisions or Congressional decisions. The status of the Air Force, and the other services, is also a reflection of *public* decisions . . . of individual decisions, if you will . . . as to how much and where, national effort and wealth will be placed in the military structure. . . .

Airpower and all it encompasses is my profession. It is also the profession of some 900,000 other people in the United States Air Force. Beyond that, it is of concern to many millions of Americans who recognize the essential significance of airpower to their security.

To make sure that we understand each other, I want you to know what I mean by airpower.

First, there is *total* airpower. This is the sum of a nation's aeronautical and astronautical capabilities . . . its national understanding and support . . . and the degree of its determination to satisfy the demands of its security. Within this national capacity is *military* airpower—the fighting forces and their support, as exemplified in the United States Air Force and in the aviation components of the United States Army, Navy and Marines.

Today, I will talk about military airpower in the future . . . specifically the United States Air Force of the future.

USAF Is Synonymous With Airpower

Just as our Army and its soldiers are synonymous with land warfare and the Navy and its sailors with sea battles, so are the United States Air Force and its airmen synonymous with air warfare.

As far back as Napoleon's time, certain visionaries recognized that the third medium—the medium of space above the earth's surface—presented a

means to perform certain military tasks better. Originally, this third medium was used to exploit reconnaissance and even as late as the beginning of World War I, the aircraft was used primarily for this purpose. Then, other leaders recognized its capabilities for attack. Thereafter, the possibilities and potential inherent in airpower caught the imagination of men such as Mitchell, Arnold and Spaatz and airpower came into its own. World War II wrote a most significant chapter on airpower into the history of war.

The compelling reason for the preeminence of airpower is clear and unchallenged . . . because those who have the capability to control the air are in a position to exert control over the land and seas beneath.

Airpower's capabilities do not invalidate the requirements for land and seapower . . . airpower complements these forces. Each of our services has its assigned missions, and certain requirements in men, talent and weapons to enable it to perform its missions.

In this age of rapid technological advances, the challenge to each service for modern and effective performance of its assigned missions is greater than ever. As far as the United States Air Force is concerned, there is neither time nor energy to waste on so-called inter-service rivalry.

Being an airman, I naturally am most directly concerned with the problems faced by the Air Force in performing its missions. By that I am certainly not implying that the Army and the Navy do not have their problems. They have big ones too. For example, the Navy has the problem concerning the submarine menace and the backbreaking task they have in developing ways and means to counter this danger to our security. Anti-submarine warfare in the age of the nuclear submarine and submarine launched missiles is a mission which will tax the talents and the skills of the Navy's best men.

The Army, too, has big problems. The urgent necessity to develop new tactics, techniques, and weapons which can survive nuclear attack from air and space and still be capable of strong ground action also places tremendous demands on the efforts of the fine men who are experienced in ground warfare.

The problems we in the United States Air Force face are also large and likewise direct results of our duly assigned missions. Our three primary combat missions are to maintain a strong, long-range striking force, to conduct the air defense of the United States and to provide and operate tactical air forces wherever they may be needed.

I consider that our present capabilities to perform each of these missions are reasonably adequate, particularly as far as the offense is concerned. But in the future we need long-range striking power which is less vulnerable to enemy attack; an air defense system that will provide the warning and control structure and defensive firepower to repel an enemy attack, and tactical air forces possessing increased flexibility and versatility.

Capability To Control Space — USAF's Next Step

A few minutes ago, I stated the concept that whoever has the capability to control the air is in a position to exert control over the land and seas beneath. I feel that in the future whoever has the capability to control space will likewise possess the capability to exert control of the surface of the earth.

We airmen who have fought to

assure that the United States has the capability to control the air are determined that the United States must win the capability to control space.

In speaking of the control of air and the control of space, I want to stress that there is no division, per se, between air and space. Air and space are an indivisible field of operations.

Ninety-nine percent of the earth's atmosphere lies within 20 miles of the surface of the earth. It is quite obvious that we cannot control the air up to 20 miles above the earth's surface and relinquish control of space above that altitude . . . and still survive.

The Air Force has been penetrating "space" for several years with manned aircraft. Men like Yeager, Everest, Apt and Kincheloe have been our pioneers.

The Bell X-2, a rocket research plane, carried man up to approximately 25 miles above the earth at 1,900 miles per hour. The X-15 rocket research plane which is now in the works, is designed for speeds and altitudes much greater than those of the X-2. The X-15 represents a joint effort on the part of the Air Force, the Navy and the National Advisory Committee for Aeronautics (NACA).

I think it is interesting to point out that in the development of this spacecraft, the airframe, the powerplant, the cockpit, and the pilot compose an integrated system.

A special pressure suit has been designed for use in conjunction with the X-15. It is here today and will be exhibited at the conclusion of my remarks.

This suit incorporates automatic inflation to provide proper pressure, a ventilation system to cool the flier, insulation against extreme cold in event the pilot is forced to bail out, and an outer garment to protect against flash fires and wind blast. You will note when you see the suit that despite all these features, it permits complete freedom of action, which the pilot must have to carry out sustained operations at high altitudes and high speeds.

USAF Perspective and Philosophy For The Future

The basic philosophy of the United States Air Force as concerns military airpower—is the requirement for an offensive force—second to none.

We believe that our possession of strong offensive power will make an enemy reluctant to attack. The Maginot Line philosophy and Goering's claim that no allied bomber would reach Berlin are examples of the danger of excessive confidence in the defense.

Naturally our defense, particularly our air defense, must be strong—but with enough money, effort and talent, we can maintain the first-rate offensive power that will make an enemy fear to strike.

No one can logically advocate the spread of our resources to provide a little bit of everything and not enough of what we need .

In the technological race to develop new equipment and new weapons to carry out our assigned missions, the Air Force is acutely conscious of the huge demand on the resources of our country. Science and industry are vital elements of these resources. Air Force experience in World War II, more than at any earlier time, showed us what science and private industry could do to make a powerful fighting force. The Air Force still depends on the skills, talent, ingenuity and cooperativeness of United States science and industry to provide us the tech-

nological lead we need in the future.

Basically, we know that we need a proven force in being which can do the job assigned to it, plus strong research, development and test for the future. We have the combat force in being and we have the finest scientific and industrial capacity in the world. We are working into the future . . . and in the future I see integrated forces of manned and unmanned systems . . . for missiles are but one step in the evolution from aircraft to true spacecraft.

It will take both types, that is, both manned and unmanned systems to perform our missions because in the future the essentials for success will still be quick reaction, reliability, flexibility, and versatility. If manned systems can perform some tasks better, then we want manned systems; if unmanned systems can do the job then we will be the first to accept and use them.

Since missiles are becoming more important to the national security, it is logical that *all* military services should share an interest in the development and use of missiles. However, it is important to note the *differences* in interest clearly, because there are marked differences that show up in mission requirements and in the matter of system completeness.

The point I want to make is that in the context of the Air Force's missions and combat technology, manned aircraft, unmanned systems and manned spacecraft join together in compatible and complementary roles to form a *functionally complete system.*

For example, there is a certain and constant inflexibility in intercontinental ballistic missile operations. Inflexibility is inherent in the requirement for precise geographical relationships between a missile's launch site and the accuracy of target locations. Inflexibility also exists in the inability to recall a ballistic missile once it is launched, in the inabilty to divert the missile from one target to another while in flight and in its known trajectory which eases the defense problem.

When target values or defensive measures call for a change in strategy or tactics—as they frequently do in war—the attack must be realigned. For this reason, these missiles must be complemented by other weapons with a greater degree of flexibility.

Missiles, manned aircraft and spacecraft, integrated in the command and control structure of the Air Force would provide functional and system completeness.

Both manned and unmanned systems function in an environment that is continuous and undivided. They have the same operational characteristics and they provide combat integrity. If circumstances rule out mission accomplishments with one method, the other method is responsive to the mission. If both methods are required, both can be applied simultaneously to the target objective. They are a *single instrument.*

As I've been discussing the offense I'm sure it has become obvious that the greatly increased potential of offensive weapons poses an ever increasing defensive problem.

Pure air defense . . . the most effective air defense . . . is to strike the enemy forces at their home bases before they get off the ground. The next best air defense would be to attack enemy forces in the air immediately after they have been launched or as distant as possible from friendly territory. The least desirable air defense, which is really a last ditch defense, is to counter the enemy over the immediate target area. Our job

that is, the Air Force job is the destruction of enemy attackers as far as possible from their probable targets. That is why the Air Force is so interested in improving its warning and control system and in the development and wide dispersal of long-range, defensive weapons.

We're not the only ones with defense problems. In this connection, I would like to point out that the presence of bases in friendly countries around the USSR—and I'm speaking not only of land bases but bases at sea as well—presents the Russians with some problems.

It is quite obvious that our airpower could be zeroed in on the USSR from every direction. This complicates the Russian's defensive problem. The Russian by nature is a realist, and I have no reason to believe that our strong strategic capability goes unnoticed on the other side of the iron curtain.

I certainly do not mean to minimize the threat that this nation faces from expanding Russian airpower. The Russians have been expending money, time, talent and effort to gain control of air and space. The experts in Russia who are responsible for their great progress must certainly know, however, that they have not yet succeeded in cancelling the effectiveness of our own airpower. But we too must be realistic. The airpower that we have today is not the answer for all time.

We feel a sense of urgency and are doing all we can to speed up our progress.

Accordingly, the Air Force has taken the following actions this week which I believe will serve to give us an earlier operational capability in the missiles field:

(1) Transferred the 1st Missile Division to the Strategic Air Command.

(2) Transferred the responsibility for the initial operational capability phase of both the ICBM and IRBM programs to the Strategic Air Command. This responsibility has previously rested with the Air Research and Development Command.

(3) Directed the entire resources of the giant Air Force Depot at San Bernardino, California, to be made available as required to support this effort.

We know where we are headed. We are going to solve our problems and hasten our progress through a mature approach, precise planning, and additional effort.

We in the Air Force feel very strongly about the missions which have been assigned to us.

We recognize that our responsibility is great, but we want the public to know that with us the capability to perform these missions well is, and always will be . . . paramount.

Homage:

One day General Pershing asked a few of us to accompany him to the Invalides, where we were to visit Napoleon's tomb, see the Museum of Napoleonic relics, a place where all the old battle flags of the Republic, of the Kingdom, and the Empire were collected. We were called for at the appointed time by the French officers and escorted to the Invalides, where everything was explained to us and where we were shown around this most interesting place. At one stage of the proceedings, the guardian took out Napoleon's sword and held it out to General Pershing, thinking that he would take it in his hand, but without touching it General Pershing leaned forward and kissed it.

—General William Mitchell's War Memoirs, p. 88.

AIR POWER, MISSILES, *and National Survival*

By ALEXANDER P. deSEVERSKY

The following is the substance of an address, entitled "Electronic Combat Power," given by Major Alexander P. deSeversky before the New York Chapter of the Armed Forces Communication and Electronics Association, in New York City, on October 23, 1957. Since Major Seversky's comments have great timeliness in these difficult post-Sputnik days, the editors are happy to bring his remarks to a broader audience in the pages of The Air Power Historian.

Major Alexander P. deSeversky needs no introduction to our readers. He is a Vice President, Trustee, and member of the Board of Editors of The Air Force Historical Foundation. His contribution to American military affairs, as an industrialist, thinker, and educator, has been recognized nationwide.

Throughout my life, whenever I foresaw a coming technological problem and offered an immediate approach to its solution, my contemporaries agreed that it was a fine idea, but wanted to know what we were going to do now. They rationalized that one cannot fight today's war with the weapons of tomorrow. But time passed swiftly, and we invariably found ourselves tackling a new military situation with the methods of the past.

The business of prediction is a thankless task. As a matter of fact, I remind myself of the Two Black Crows, the famous comedians of the '20s. One of them asked the other, "Bo, what you do now?" "I'm in a minstrel shows." "In a minstrel show? What do you do in the minstrel show?" "I'm the head man." "The head man?" "Yes, I'm ahead of everybody." "Yes, you're so far ahead of everybody you're not even in it."

However, with the Sputnik in the sky, there isn't much "lead time" left for earthly prognostications. We have reached the maximum in global mobility. Interplanetary communication and travel, of course, are extremely intriguing, but we may never achieve them unless we first put our mother planet in good order. And the world is in great danger. As I stated seven years ago in my book, *Air Power — Key to Survival*:

> "Communications and transportation have shrunk this planet to such a degree that the permanent coexistence of two violently opposed social and moral systems has become difficult if not impossible. Either one ideology will succumb to the other through persuasion, infiltration, and contamination—or a military showdown will become unavoidable."

Since then the differences between the ideologies have, if anything, sharpened. We are witnessing the actual dichotomy of the world into incompatable, antagonistic halves. Geographically we are divided into East and West; ideologically into Communism and Capitalism; technologically, economically and militarily into two opposite camps, one dependent upon the U.S.A., the other upon the U.S.S.R. Under the impact of a cold war, these two opposing masses acquire an ever greater energy potential, and it is only a matter of time before a discharge occurs in its most violent form. National defense, therefore, must be uppermost in our minds.

Everybody agrees that free people must be invincibly strong, yet there is no agreement as to how we should achieve that strength. While we still debate this question, the weapons of war become ever more powerful, nuclear warheads infinitely more devastating. Some scientists already predict that a bomb could be designed to blow our planet to bits. If that can be done, I am sure someone will design one. If he designs it, he unquestionably will build it. And when it is built, he will not be able to resist the temptation to detonate it, just for the hell of it, to prove it can be done. In that case, of course, the problem of national defense will be greatly simplified. As a matter of fact, all our problems will be greatly simplified. But the trouble is that nuclear weapons are not only growing bigger, they are getting smaller. What we witness now is simply the replacement of TNT by nuclear explosives, more powerful and extremely flexible tactically. Such a warhead can be tailor-made for any size or type of target. This new explosive has increased immensely the firepower of the armed forces of both belligerents, on land, on sea, and in the air, but in itself it has not changed the strategic relationship of the protagonists. It is not the new explosive, but the new methods of its delivery, which revolutionize warfare. Therefore it is not the size of the stockpile of atomic bombs, but the superior means of their delivery, which will decide the issue.

Air Power and Space Power

As in the past, the question will be who gets there "fustest with the mostest." This has been true of everything from bows and arrows to satellites. The prediction that whoever puts the first satellite into the orbit of the earth will control the world is just nonsense. If you can place a satellite in space, you can shoot it down. So even that kind of a war is bound to evolve into a war of attrition. Who gets there "fustest with the mostest" satellites will win the war.

With atomic warheads becoming common to all military forces, the supremacy of the Air Force as an instrument of war lies, not in the nature of the explosive it employs, but in its superior and global combat mobility through the air medium, as contrasted with the inferior and geographically limited combat mobility of land and sea forces in their respective mediums. In order that we understand the character of modern war, it is very important to define air power. Like the weather, everybody talks about it, but no one bothers to analyze its nature.

Three years ago I wrote a Definition of "Air Power" for the *American People's* Encyclopedia, and have now finished another, for the Air War College and the *Encyclopedia Americana,* which embraces missiles and extends the concept into space. In brief I submit that *air power is the ability of a nation to assert its will via the air medium, and the military instrument*

by which a nation applies its air power is an Air Force. However, with the appearance of rocket motors and other forms of reactive propulsion, we no longer necessarily rely on atmosphere for our sustenance or propulsion. Thus the influence of the Air Force has expanded into space. I maintain, therefore, that *air power is space power, and extends from the surface of the earth into infinity.*

We must realize that even at the present state of the aerothermodynamic art, there appears to be no eventual limit to the speed, range or altitude of manned vehicles. Man has already flown four times faster than a bullet; faster than a 16-inch shell; and faster than some ballistic missiles. Thus in modern war, aircraft, missiles (ballistic and guided) and hypersonic manned vehicles will intermingle in the self-same space above.

The air ocean and its endless outer space extension are one and indivisible, and should be controlled by a single, homogeneous force in consonance with the military axiom of economy of force and unity of command. It is this concept that points to a new military establishment if such is to be properly attuned to the technology of our times. So whenever I refer to air power, I mean air and space power. The words aircraft, missile and rocket, when used by me in the abstract strategic sense, are synonymous and interchangeable.

Technological Progress

With this in mind, let's now review briefly the progress of recent military technology and America's reaction to that progress.

When Russia, after World War II, made an about-face from ally to potential enemy, Washington — despite the warnings of those who knew better — was complacent. We had the atomic bomb, they insisted. It might be a decade or a score of years before the Russians could develop a nuclear weapon. But Russia exploded its first atomic bomb in 1949. Were we exercised and worried? Not at all, because the government assured us that we were going to develop a hydrogen bomb which, being one thousand times more powerful, would make the Soviet bomb look like a firecracker. And we did explode, in November of 1952, a hydrogen device.

But it was Russia who first exploded an airborne hydrogen bomb, in November of 1955, six months ahead of us. To the consternation that followed, we replied, "So what? They will never solve the nuclear production problem. Why, that requires highly developed engineering skills, vast industry, technological know-how—they are bound to bog down in their effort." But when Russia began to explode nuclear weapons like so many toy balloons on New Year's Eve, the American people once again became concerned, and once again relaxed. "The Russians can never deliver their bombs. They don't even know how to build jet aircraft. True, in May of 1954 a single, four-engine jet bomber flew over Moscow. One aeroplane. Probably hand-made, a flying mock-up. Just propaganda." A year later a flock of these bombers flew over Red Square: a much greater number than we had in commission of the Boeing B-52, the mainstay of our Strategic Air Command. "How come?" asked John Q. Public. The answer was, "Don't you know that jet aircraft are obsolete? Why we are going to lick them with ballistic missiles." So everyone relaxed again. On August 26th, Russia announced that it had fired the first ballistic missile. "Pay no attention," said Washington. "We will beat them to the earth satellite.

Whoever puts the first satellite into the orbit of the earth will control the world." But it was the Soviet Union who launched the Sputnik, and all at once Washington cut the satellite down to size and said it was just a little ball. It couldn't do any harm. Running out of alibis and alluring promises of superior phenomena, Washington began to back-pedal. "Never mind the Sputnik and ICBM. We still have our jet aircraft with which we can lick them" — in spite of the fact that they themselves only recently declared that jets were made obsolete by the ICBM. And accordingly we slowed down the production of our B-52 bomber from 20 to 9 a month.

What is the cause of our great technological tardiness? Could it be the dearth of scientific and engineering talent? Or lack of production know-how? Of course not. We are still the greatest industrial power on earth. With 600,000 scientists and engineers in our midst, as of today we lead Russia by 25 per cent in the technological brain power pool, though we must admit that they are catching up with us dangerously fast.

The reason we have reached a state of military inferiority vis-a-vis Russia is *not* that there is anything wrong with the American scientific creative genius, but that our talent is condemned by military orthodoxy to labor within the confines of an outmoded, fallacious framework.

The Human Arts

Nothing could be more dangerous than the loss of faith by the American people in their technological superiority. Strategies can be changed. Organizations can be revised. Individuals can be replaced. But there is no substitute for native ingenuity. Nor is there any need for us to worry on that score. Our current inferiority is not scientific, but strategic and tactical. It is extremely important there is a clear understanding that the word "inferior" refers to the military characteristics of our weapons and not to their engineering properties. Let me give you a homely example by way of illustration:

A horse-driven piece of artillery can be more ingenious in many respects, from a purely engineering point of view, than a self-propelled, motorized piece of artillery. The horse driven carriage may have all the engineering intricacies of an automotive vehicle. It may even incorporate an internal combustion engine with all of its complexities, or even jet or rocket power in order to assist the horse in its daily work. The horse itself can be controlled by microwave bridles to make sure that the animal distinctly hears, through its hi-fidelity earphones, "giddy-ap!" As a final touch, there could be an automatic feeder of oats and water, and of course a mobile incinerator with electrostatic precipitator to dispose of the residue.

Thus, in all its engineering details, it can be a manifestation of superb scientific ingenuity. Yet such a deluxe horse-driven vehicle would prove inferior on the field of battle to a self-propelled motorized vehicle. The basic fault would lie, not with the engineering, but with the military decision to employ horse-driven vehicles instead of self-propelled vehicles.

I have purposely used this far-fetched analogy, of course to make my point that there is a world of difference between military inferiority and engineering inferiority. Thus a superlative engineering product can, in fact, be inferior militarily. A technologically superior nation, therefore, can easily be defeated if its creative talents are misapplied.

Our current plight vis-a-vis Russia lies, as I see it, in our strategic thinking, which despite the new fantastic weapons is still stuck in the mire of World War II, and even World War I, thinking.

Instead of developing a new strategy that takes full advantage of the new technology, we are trying to cram the new technology into the old strategic bag. We waste our industrial know-how, our scientific and engineering talents — the most precious commodity we possess — on all sorts of irrelevant military projects. We are building all kinds of electronically-controlled horse-and-buggies. We are still perfecting deluxe invasion barges, and the rest of the paraphernalia of super amphibious task forces to invade, some time, some place, if and when the air war is won. Simultaneously we are lavishing billions on all sorts of contraptions being designed for ground warfare, full of electronic ingenuity and wizardry, from infra-red kitchens, booby traps and obsolete tanks to low-performance organic aviation of ground forces. These, too, just like invasion barges, are frozen assets that can be used only if and when the air war is won.

And think of Naval task forces, that cost us five billion dollars a throw, built around strategically obsolete aircraft carriers which are capable of launching only a handful of aircraft and missiles that are inadequate to defend their own task force, much less to attack the Eurasian land mass against fantastic odds. The transformation of a conventionally-propelled Navy into an atomic Navy has no strategic significance. The new 80,000-ton, giant economy size atomic aircraft carrier will be sunk just as swiftly as its smaller version if it ventures within striking range of enemy air power which, by the time of its commission, will be global. This surface Navy, designed to project our air and missile power via slow-moving, man-made, floating islands is nothing but a costly yet feeble attempt to compete with the Strategic Air Command's direct and swift intercontinental capability. Yet this senseless, purely jurisdictional dispute absorbs a vital portion of our creative minds and scientific effort. Like the battleships at Pearl Harbor, these new ships of the line will be at the bottom of the ocean before they know they are at war, unless they have enough warning to retire for the duration to well-prepared positions in the Byrd-land of the South Pole. They will survive there only because the enemy will ignore them. They will regain their usefulness only if and when the air war is won; but even then they will be a needless luxury. Russia has no overseas bases, and yet she does not spend billions on floating islands. She pours these billions, instead, into ballistic missiles and long-range Strategic Air Command.

Vested interests clamor, too, for a bigger and better Tactical Air Force, insisting that the major mission of air power is to support our ground forces in so-called Brushfire, or little baby wars all over the surface of the earth. Well, I'll let you in on a little secret: There aren't going to be any little wars, Turkey and Syria notwithstanding — that is, of course, unless we take leave of our strategic senses. Such little wars, whether fought with bayonets or atomic shells and bullets, or even atomic BB shots, can never be decisive. Whether our ground forces fight on camelback or mules, or in tanks or "low-performance aircraft" as surface strategists advocate, they can never alter by one iota the power relations between the main protagon-

ists. Limited wars can be fought only with the consent of the belligerents and, therefore, are bound to end in a stalemate. At best they are a reconnaissance in force, useful to gain a better knowledge of the enemy's capabilities and his political intentions, with the inevitable result of disclosing our own hand. Korea and Suez are proof that little wars will always end precisely where they started, the status quo prevailing, unless they explode into a major atomic conflagration. The only difference between a limited war fought with conventional warheads and one fought with nuclear warheads is that in the latter case the small nation in dispute will be more thoroughly decimated than Korea.

Unification

It may well startle you to learn that, in spite of all the lip service the Government pays to it, the Air Force does *not* get the lion's share of the national defense budget. It is an optical illusion, a numbers racket pure and simple. Out of 17½ billion dollars of current Air Force appropriations, I figure that 4 billion dollars are being spent by the Air Force on Tactical Aviation, Troop Carrier Command, Transports and Cargo planes that will be useful only if we fight a full-fledged ground war. And that again can never be fought unless the major global air war is won first. Therefore, those 4 billion dollars should actually be on the Army side of the ledger, leaving the Air Force holding the bag with only 13½ billion — exactly what the Army gets. Because of the Army's original 9½ billion we must add the Air Force's 4 billion — which makes 13½ billion dollars, even Steven. The Navy is supposed to get only 11½ billion dollars, but if to this we add all the direct and indirect national effort in the field of atomic energy to convert our Navy into an atomic Navy, it probably is getting the benefit of the same figure — namely 13½ billion dollars.

So we go blissfully along, developing three separate strategies and dividing the appropriation pie as evenly as possible; and with that goes division of available scientific talent, both domestic and foreign-born, on a sort of "catch-as-catch-can" basis. We are building in every direction, trying to be strong everywhere, scattering our scientific and industrial effort over the entire spectrum of weapons from bayonets to Sputniks. As a result we are weak everywhere and, by default, are surrendering to the enemy our military technological leadership in the decisive field of aerial warfare.

In spite of the fact that Russia exploded an atomic bomb in 1949, and that the Korean war disclosed they were in full production of jet aircraft of all types, the then Chairman of the Joint Chiefs of Staff, assured the American people that he was against any fundamental changes in our military setup, saying that, "if such changes come, they will come gradually as a process of evolution."

After this policy statement Russia exploded the first airborne hydrogen bomb; overtook us in production of intercontinental jet bombers; went into production of intermediate range ballistic missiles (of which we had none); and was well on the way to developing the intercontinental ballistic missile— all of which, in effect, readjusted the international power relation to the advantage of Communism and to the detriment of the free world. Yet the Secretary of Defense commenting on the 1957 budget, found it possible to state, "Nothing has occurred in the international situation during the past

year which would indicate the necessity for any major changes in these policies and concepts."

To me, the President's statement on September 24th was even more disheartening. He stated, "The United States is maintaining the most powerful military establishment in our peacetime history." That is correct in the abstract. We have the most powerful military establishment in our peacetime history. But by the same token, never in our history, whether at war or in peace, have we been so weak in relation to our potential enemy. This is the truth that the American people ought to know, and to know quickly, if we are to survive. Yet the official reaction to the Sputnik is to dismiss it, not only as a useless scientific trick, but as the greatest Soviet blunder. Sherman Adams, in a talk in San Francisco, said that our purpose is not to rack up a high score in a basketball game played in outer space. And another Presidential Assistant, Clarence B. Randall, on October 21st dismissed Russia's earth satellite as a silly bauble. All this might be very funny if it were not so tragic.

It is this smugness, conceit and "über alles" attitude that finished Germany, which may be responsible for the present plight of the U. S. I have been critical of certain key members of our defense establishment; but their attitudes and actions are not so much the product of their own military astigmatism as of the fallacious setup within which they are forced to labor. We will never get anywhere until Congress repeals the Unification Act of 1947. Neither fish, fowl nor flesh, unification is the basic obstacle to the development of a sound and realistic strategy. And this is not an afterthought. You will find these very words in *Air Power — Key to Survival,* written 7 years ago, protesting that the Unification Act as passed by Congress in 1947 and amended in 1949 contains the seeds of military disaster. The first thing Congress must do is to repeal that law, and create a new establishment attuned to the technological realities of our time.

In my article in *THIS WEEK* magazine in 1955, I warned the American people that more money for national defense was not enough. I stated, "The whole military philosophy must be changed, or we shall forever trail the rest of the world not only in conventional aircraft, but in intercontinental ballistic missiles and even in man-made earth satellite development."

We must remove the curse of the balanced forces strategy, and free the American creative genius from the confines of this outmoded concept.

The very fact that my postulates have proven accurate convinces me that no matter how widely we pool the creative talents of the West, as the President suggests, they will come to naught unless and until we have a correct organization to take full advantage of those talents.

The Navy is about 90% Air Force and wants to project its power through the air and space above by planes and missiles. The Army likewise clamors for its own independent aviation service in order to project *its* power through the air and space above with planes and missiles. It is ridiculous for three separate agencies to fight the self-same air war whether with planes, missiles or manned vehicles. The time is long overdue for us to integrate our three services into one single military force, with one uniform, one promotion list and a single staff. The new establishment must be, for all practical purposes, a congenial Department of the Air, in which we have a Bureau of Ships, a Bureau of Ground

Forces and bureaus of other auxiliary units. Such changes cannot be expected to come from the Pentagon. Even though some of our top military leaders individually see their wisdom and timeliness, as a group they are entirely too regimented under the present setup to make such recommendations with impunity.

There is only one source from which the necessary changes can come, and that is the American people, bringing pressure on their representatives in Congress. But they cannot act unless they are brought to realize the dangers inherent in our present military system. A thoroughgoing public debate on the subject of our national defense and foreign policy is a vital necessity.

The Peril Ahead

That is why the present public concern over the U.S.S.R.'s military ascendancy should not be artificially allayed by half-truths, distortions and outright deceptions. In a free republic such as ours, the Government is helpless unless it has the benefit of an enlightened public opinion, and that opinion can never be formulated unless the American people are given the unadulterated facts. This is the only policy that Washington can pursue if it is to stave off disaster should another war be forced upon us — and at this moment there appears to be no escape.

It is inconceivable that two opposing and irreconcilable ideologies can be expected to live in peace and blissful coexistence while at the same time arming to the teeth in the greatest weapons race the world has ever known. An eventual military showdown seems all the more probable when one side has openly vowed to enslave the world and the other side is equally determined to retain its freedom.

Furthermore, what seems to our minds an appalling horror may be a mere bagatelle to the ruthless enemy. After all, the Communists did not hesitate to liquidate twenty million of their own people to perpetuate themselves in power, and the same regime will not hesitate to kill off twice or thrice that number of people, anywhere, to achieve by force its goal of world domination, should its present methods of infiltration and subversion fail. Thus, only the miracle of the spontaneous collapse of the Soviet State from within can prevent another global war. But this possibility is highly remote as long as the U.S.S.R. imbues its people with admiration for their military and scientific prowess. Then what must be our course? We cannot overtake Russia in long-range jet aircraft or ballistic missiles. The best we can do is to equal their capabilities, and live in constant dread of nuclear attack.

But fortunately for us, that balance will not last forever. Therein lies our opportunity to gain once more the upper hand. Throughout history, the advent of each new weapon seemed at first to provide an unimpeded offensive means for its possessor. But eventually and inevitably an appropriate defensive was developed, and the offense-defense balance was restored.

The nuclear warhead is no exception. Its devastating power will ultimately be balanced by the difficulty of its delivery to the target. Each war differs radically from the preceding conflict. World War I was static, characterized by trench warfare. World War II, on the other hand, with its motorized equipment and air power, was highly dynamic and mobile. The next war will differ from the last by again becoming static, a paradox in view of the fact that it will be fought at hypersonic speeds. The strategic

picture will be not unlike that of two immobile fortresses, shooting it out with long-range weapons.

With the ballistic missile a reality, the maximum in offensive power has been reached. There is no sense in building an ICBM that will spin three times around the earth before it hits its target. It is only natural, therefore, that the scientific energies and resources of the protagonists will be channeled automatically into the defensive effort. Scientific interception, with its ensuing attrition, will compel the quantitative expansion of the offensive means, which will further strain the economies of the opposing nations. The present atomic stalemate is bound to evolve into the centuries-old balance of power, when the destruction of the military force of one side can be accomplished only through a protracted attrition inflicted on the enemy by the forces of the other side. A climactic battle once again will be the order of the day. That climactic battle will be fought in the air and space above, not only for air and space superiority, but primarily for electronic superiority. Thus electronics become combat power in fact.

In developing this defensive capacity, I maintain that we must be guided by several fundamental assumptions: One — we must recognize that speed *per se* is no longer a defensive feature of offense. No matter how fast a missile streaks through the air or space, it can be stopped. Stop the means of delivery, and what it carries no longer matters. The second fundamental to recognize is that in a short time the range of detection of airborne vehicles by various scientific means will expand throughout the entire circumference of the globe. The surprise attack will be impossible, unless one side is fast asleep. Thus penetration will depend, not on speed and not on surprise, but on the ability to counter-measure the energy impulses of the defense. Once we reach that stage, it will be not a physiological or technological, but purely tactical decision whether a robot or a human mind must guide the vehicle. In general, robots are too logical. Their reaction is predictable; they are easier to intercept. It will take the erratic human mind with its intuition and power of choice to baffle and outwit the defense. That is why I am convinced that, for any predictable time, the hypersonic, manned vehicle will be the decisive weapon in any future war.

It is true that a robot can be perfected to duplicate the reactions of the human brain. But such a device will be enormously complicated and costly. That is why I maintain that the true push-button war, though a scientific possibility, is an economic absurdity.

The Outlook for the Future

In summing up, it is clear that America still has a way out of its present predicament. We have another, perhaps the last, chance. This chance lies in developing a highly efficient interception complex via our overall superior electronic combat power, since in addition to our technological leadership in these related sciences, our country is uniquely equipped for this kind of warfare. I have always been convinced of this. Writing in 1950 I stated as follows: "America is virtually encased in a close-woven fabric of electric wiring and radio carrier waves that can be utilized for electronic defenses without interrupting light, power and communications. Despite its industrial progress, Russia remains comparatively primitive in this respect. It will be another generation at least before its gigantic spaces can be efficiently wired. Until then gapping holes will remain in the Soviet

electronic shield."

Although Russia has made vast technological advances in the intervening seven years, its standard of living has not improved appreciably. On the other hand, the United States has greatly expanded its telephone, telegraph, ticker tape, teletype and microwave facilities — to mention only a few — which virtually wired for defense a hundred and sixty million Americans. This highly efficient communications web is already in existence, representing hundreds of billions in investment, and is the product of our free enterprise and industrial civilization. Any government, no matter how autocratic, would go broke and run out of time and manpower — including slave labor — attempting to create a similar complex by forced draft.

Just to illustrate the utility and vastness of the undertaking, last year alone the military paid hundreds of millions of dollars for the use of telephone, telegraph and other types of communication facilities as a part of defense expenditures. Besides these physical assets, there are the unique and ready-made skills of our population.

It is true, as Khrushchev said, that Russia is no longer a peasant country. But it is still a mixture of peasant and scientist, while the United States is a mixture of scientist and mechanic, since every boy in this country is brought up on mechanical gadgets. In the race for interception, the entire range of human resources will have to be harnessed. Ours are in being, and enormously superior in the scope and skills required.

Don't misunderstand me. I do not advocate an electronic Maginot Line, nor do I advocate defensive strategy, because the military principle that only offense can win a war is as true today as it has been through the ages. What I tried to clarify is that the *defense*, in the modern context, consists of combat interception the moment the enemy is airborne five thousand miles away. It is a continuous electronic battle. Likewise, the *offense* will have to fight its way to the target the moment it is airborne for attack. Both offense and defense are an integral part of the overall battle for command of the air, the space above, and the electronic right of way.

Thus it is clear that our first objective is to create a long-range striking force—ballistic, rocket and airborne—operating directly from this continent, since overseas bases are no longer tenable. Such striking force must possess superior power of countermeasures to neutralize the enemy defensive means in order to reach their vital targets. Second, we must have a defensive force on our continent that has superior power of counter-countermeasures to decimate the enemy's attacking force. This is the only area in which we, as a society, still have a clear edge of superiority over the U.S.S.R.

The only real piece of propaganda which has come from Russia recently is Khrushchev's statement that jet bombers are already museum pieces. I am sure he knows better, and made the statement with his tongue in his cheek. With Soviet long-range bombers coming off the production line at a rate 400 per cent greater than ours, Khrushchev's outburst might have been a cunning ruse: For while we strain every effort to achieve parity with the U.S.S.R. on the ICBM some time by 1962, we may be forced to do so at the expense of our Strategic Air Command in being. Meanwhile Russia may attack us at any time before that date, and smother us like a cloud of locusts.

We must never forget the way we

smothered Germany with wave after wave of our ten-year-old crates such as the B-17 and B-24, in spite of Hitler's V-1s, V-2s, jet bombers, rocket interceptors and other scientific novelties. Therefore our program must be as follows:

One: Our jet-propelled Strategic Air Command must be increased immediately by the factor of 4. Its sustained range *must* be increased and its survival in any united surprise attack by the enemy must be assured. The production of intercontinental bombers must be a 7-day week 3 shift operation.

Two: We must intensify our ballistic missile effort to achieve parity with the U.S.S.R. in the shortest possible time.

Three: We must immediately exert the maximum effort to develop antimissile missiles for interception of the ICBM, which I personally never considered an insurmountable problem, through the method of collision.

Finally, we must also exert maximum effort to create the most efficient Continental Air Defense through expansion of our communications, electronics and guided missile production.

These things must be done if everything else is cut to the bone. Everybody is against extravagance, just as everybody is against sin. But let us have one thing clear: Ordinary economy and thrift can save us just *millions;* only a complete revision of our strategic concept and the foreign policy which it buttresses can save us *billions* and yet increase our strength. We have no right to demand sacrifices from our people as long as our military effort is only about 50 percent efficient. We must give up the "misguided attempt" to maintain the military forces and weapons systems that have no longer a legitimate mission but are kept through inertia, sentiment and tradition.

I respect and admire tradition. I value the importance of esprit de corps. But when these fine heritages interfere with human progress and threaten our very security, I feel that we must have the moral courage to relegate them to the nostalgic past and to make the necessary fundamental changes in our military setup. The question is whether we will have the wisdom to make that move as a product of logic, or whether it will be forced upon us by the march of events, in which case the change may come too late.

The Sputnik may be a blessing in disguise, a warning light that must arouse us to action.

The Central Problem:

America, in the years following World War II, has achieved a rate of economic growth and a general level of prosperity unparalleled by any nation in any period of history. This domestic achievement is counter-balanced on the international front by an unprecedented threat to this nation's future security. Soviet communism has built a war machine which matches or surpasses that of the West in many significant respects. Repeatedly the best estimates of the United States authorities concerning Soviet technological capability have proven inaccurate. The Soviets have broken the atomic monopoly; they have made rapid strides in the development of their strategic air power and industrial war potential; Soviet conventional forces outnumber those of the West.

America, despite her great military and economic strength, has thus far been unable to galvanize the West into an effective counter torce, even though the Hungarian and Polish uprisings and unrest within the Soviet Union offer valuable opportunities to be seized. To meet the threat and to seize opportunities requires that the best trained and most experienced minds be brought to bear on the key international issues on which the nation'c long range future hinges. . . .

From "Reflections on the Quarter," in *Orbis,* Vol. I, No. 1, April 1957, p. 3

ATMOSPHERIC *Space Equivalence*

By DR. HUBERTUS STRUGHOLD,

At an age when most men are beginning to think about retirement, Hubertus Strughold, M. D., survived the ruin of his nation in war, emigrated to another land, invented a new career for himself in a field of human endeavor as fresh as tomorrow, and became internationally renowned as the sage of space medicine.

Dr. Strughold was born in Westphalia, Germany, in 1898. He studied medicine and natural sciences at various German universities, receiving his doctorate of philosophy in 1922 and his medical degree a year later.

In 1935, as the Luftwaffe began to revive with the approach of World War II, Dr. Strughold was appointed Director of the Aeromedical Research Institute of Berlin. His position gave him the nominal rank of colonel in the Lutwaffe and also brought him two military crosses and decorations from the governments of Hungary, Sweden, and Yugoslavia, for his contributions to aeromedical knowledge.

As the Russians closed in on Berlin early in 1945, Dr. Strughold succeeded in escaping from the beleaguered city to the protection of advancing American forces. He took with him the key members of his staff, constituting top aeromedical specialists in Germany.

Under U. S. Air Force auspices, Dr. Strughold was appointed Director of the Physiological Institute at the University of Heidelberg. With his associates, he began an exhaustive treatise on the research performed by Luftwaffe scientists during the war, later published in two volumes as German Aviation Medicine in World War II. *They were invited to move to with the School of Aviation Medicine at Randolph AFB, Texas.*

It was at Randolph, two years later, that Dr. Strughold organized the now famous Department of Space Medicine, to study medical conditions affecting flyers in rocket craft outside the earth's atmosphere.

This article is the substance of a speech given by Dr. Strughold at the Fifth Congress of the International Astronautical Federation at Innsbruck, Austria, August 2-8, 1954, and was published in the Journal of Aviation Medicine, *August 1954. Reprinted with permission.*

In all fields of science, a clear definition or concept is sometimes just as valuable as a successful experiment, for both research and teaching. This is especially true in scientific fields which are apt to invite wild speculation from the outside—such as that of space flight. In this field, the concept of the functional borders between atmosphere and space, which was developed by members of the department of Space Medicine, USAF School of Aviation Medicine, Randolph Field, Texas, in 1950, has

proven to be very fruitful and enlightening.

It is based upon consideration of the various functions of the atmosphere as a whole with respect to manned rocket flight.[10] At the altitudes where these various functions cease, we meet the respective functional borders of space. They are not found on a single topographical line at the outer limits of the atmosphere as defined by astrophysics (about 600 miles),[15] but rather at various altitude levels.

The concept of these functional borders also led to the term "aeropause" (K. Buettner).[3,4] This comprises the entire area of the atmosphere within which the functional borders of space are found, starting above 50,000 feet. The value of an approach of this kind lies in the fact that it clarifies the belief that in the upper atmosphere we deal with a radically different environment, compared with the familiar one encountered in the conventional flight zones including the lower part of the stratosphere.[6, 19]

In this paper the term "space equivalent" will be used to denote the conditions found in the stratosphere and the upper atmosphere.[20] The applicability of this concept partially overlaps that of the functional borders of space. Further, it can be applied to conditions which are not confined to any specific level or border—such as the zero-gravity state. And finally, because the term "equivalent" is found in many languages, it is well understood internationally. (French: *équivalent à l'espace;* German: *Weltraum äquivalent;* Italian: *equivalente allo spazio;* Spanish: *equivalente a los espacios.*)

In this broad range of applicability the concept of space-equivalence is especially apt in showing how far we have actually come toward the conquest of space. In the discussion that follows, emphasis will be given to those space-equivalent conditions which are physiologically of decisive importance.

Oxygen: As has been explained in several papers,[19,21] the atmospheric function of contributing to respiration ceases when air pressure drops to 87 mm Hg, because of the peculiar chemical composition of the alveolar air.[1] This is further supported by the fact that the time of useful consciousness (of man)[12] and the survival time (of animals),[7,13] after an explosive decompression to or below this air pressure, show a constant minimal value. At the corresponding altitude of 50,000 feet, therefore, we are beyond the range in which atmospheric oxygen contributes to respiration. We have reached the physiological zero-point in the oxygen pressure of the atmosphere, even though oxygen physically is still found there. The situation is the same as if we were surrounded by no oxygen at all, as in space. Therefore, at 50,000 feet or above, we face a space-equivalent condition physiologically with regard to oxygen.[19]

Liquid State of Body Fluids: It has been shown experimentally that the body fluids of warm-blooded animals start to boil at an air pressure of 47 mm Hg.[1] When this happens, the barometric pressure is equal to the saturated vapor pressure of body fluids at 37°C. At the corresponding altitude of 63,000 feet, then, we are beyond the range of air pressure which is necessary to keep our body fluids in the liquid state. Here we have reached the physiological zero of air pressure even though physically there is still some pressure left. It is the same as if we were surrounded by no pressure

at all, as in space. Thus, at 63,000 feet and beyond, we are under space-equivalent conditions physiologically with regard to barometric pressure. For more detail, especially concerning variations, see Reference 1 and Reference 5.

Necessity of a Sealed Cabin

At an altitude of about 80,000 feet we require a kind of cabin which is the prototype for future space ships or artificial satellites. This is the sealed cabin. It becomes necessary for the following reasons:

1. Technical. Due to the low air density, compressing the ambient air with present-day equipment is technically prohibitive.

2. Thermodynamic. Compressing the rarified ambient air to a physiologically useful range would produce a temperature of about 400°F in the cabin, and such temperatures would be intolerable for the occupants.[14]

3. Toxicological. Ozone, and possibly other irritating chemicals, would be drawn into the cabin by an ordinary compressor at these levels of the atmosphere.

For all of these reasons, the conventional cabin, pressurized with air from outside, must be replaced by a sealed cabin, pressurized from within. The need for such a cabin is itself a space-equivalent condition. For, above the level where it becomes necessary, the atmosphere is just as useless for pressurization purposes as is the vacuum of space.

The three space-equivalent conditions which we have discussed so far are caused by the loss of properties intrinsic to the atmosphere. Now let us consider some space-equivalent conditions which are the result of extra-terrestrial factors originating in space itself: radiation and meteors.

In the lower regions of the atmosphere these extraterrestrial factors either are not found at all or have changed their original form by interaction with the atmosphere itself. However, at higher altitudes they approach increasingly toward the full force of their solar or cosmic origin and finally create space-equivalent conditions of their own, still within the atmosphere.

Cosmic Rays and Meteors: Most frequently discussed among these extraterrestrial factors, are the primary cosmic rays (especially their heavy components) and meteors. The upper absorption limit for the heavy primaries of cosmic radiation lies at 120,000 feet.[17] The same limit for meteors is at 400,000 feet.[11, 22]

In the vicinity of the earth, however, we are protected from half the total of both kinds of matter by the bulk of the earth itself. Under these circumstances we may better speak of *semi-space equivalent conditions.* Other variations in their intensity should be noted. Among these is the effect of the earth's magnetic field on cosmic rays below a certain magnetic rigidity. Another is the effect of the earth's speed on the collision energy of meteors. These effects have been discussed elsewhere.

Ultra Violet Radiation. The space-equivalent altitude for the sunburn producing ultra violet bank of solar radiation (3,000 to 2,100A) lies above the ozonosphere at 140,000 feet.

Scattering of Visible Light. More important physiologically may be the loss of the atmosphere's power to scatter visible light, resulting in the so-called twilight or darkness of space. This space-equivalent level is reached at about 400,000 feet.

Propagation of Sound Waves. It may be noted here that, at about this same level, propagation of sound waves becomes impossible. This silence of space is reached when the free pathway of molecules in the air becomes of the order of the wave-length of sound.[2, 16]

All the space-equivalent conditions which we have discussed so far, with their variations, have one thing in common. They are found at certain topographically fixed levels of the atmosphere. Their effects would occur even in a vehicle floating freely or at rest—if such a thing were possible—at the respective altitudes where they are found. Hence, these may be called *space-equivalent conditions.*

The Gravity Free State

One important space-equivalent condition occurs within the atmosphere, however, as a direct result of the vehicle's own movement. This is the phenomenon of weightlessness, or the gravity-free state.[8, 10]

It is true that the force of gravity decreases with the inverse square of the distance from the earth's center. At a height of 4,000 miles above the earth's surface, or twice the earth's radius, it is only ¼ what it is on the ground; at 8,000 miles it is only 1/9, and so on. At a distance of 36,000 miles it is reduced to a mere 1/100. The near gravity-free state at this altitude is indeed a static condition. But it could only be valid for a supported body—one lying, for example, on a tower 36,000 miles above one of the earth's poles, if such a thing were conceivable. In practice, no one could ever experience this condition.

With a vehicle in flight, however, the situation is quite different.[9, 19] Subgravity and zero gravity can then be produced at any height. The effect is produced by the motion of the vehicle itself when the force of inertia, or centrifugal force, counterbalances the gravitational force of the earth. Ex-

amples are found in certain parabolic flight maneuvers, in the orbit of an artificial satellite, or in a free fall.

In all these cases, diminished weight is a dynamic phenomenon, not a static one resulting from a topographical location. In an aircraft near the earth's surface it can be produced for several minutes. Above 120 miles where atmospheric drag is insignificant, it can be produced almost indefinitely.[16] This is the nearest feasible orbit of an artificial satellite. In space, zero gravity is the typical gravitational condition of any moving body. Since it is produced by motion, it is a *dynamic space equivalent condition.*

No object in space is ever at rest. Perpetual motion is the normal state of the physical universe. Nor is there any point in space where the gravitational field of the earth—or of any other matter—ceases to exert some force, however small. Hence, the concept of static gravitational space-equivalence is purely theoretical and is of no significance to us.

But the concept of dynamic gravitational space-equivalence, which opposes one motion and one force against another motion and another force, is of the utmost importance to us. For it demonstrates that, in flight, we may undergo an experience which is typical of space at any altitude, if only for a brief interval.

Flight In Space

The concept of space equivalence shows us where we stand today in the advancement of flight. In the area where we encounter one or several—but not all—factors of typical space, we deal with a *partial space equivalence.* This region begins at 50,000 feet. Above 120 miles all the factors characteristic of space are met. Thus, if we ignore some minor variations, we face here a *total space equivalence* within the earth's atmosphere.

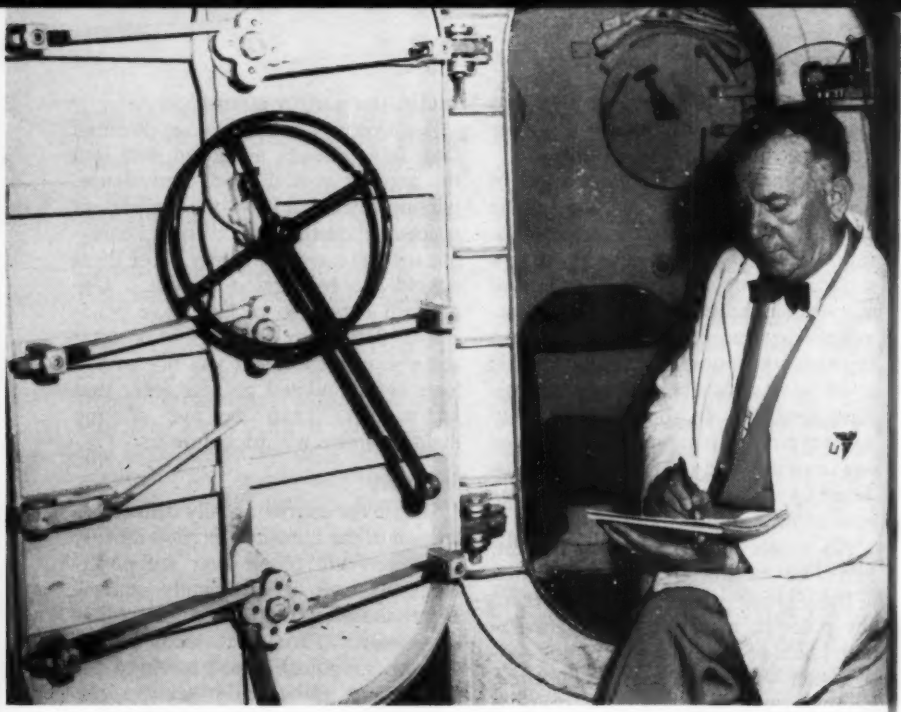
Today's manned rocket-powered craft have already advanced well into the area of partial space-equivalence, passing beyond at least three important space-equivalent levels. Animal-carrying rockets have left nearly all of them behind [not to mention Muttnik]. Unmanned two-stage rockets have penetrated deep into the region of total space equivalence. It will not be too long before piloted rockets enter that region too. Then the age of true flight in space will be before us.

Summary

Within the astronomically defined extension of the atmosphere (600 miles), conditions are found that are physiologically and/or technically equivalent to those existing in free interplanetary space. Those that occur at certain topographically fixed levels of the atmosphere are termed *static space equivalent conditions.* The levels where they begin are identical with the "functional borders" of the atmosphere. Some of these space equivalent conditions are caused by the loss of certain vitally important atmospheric factors, which loss results in anoxia, boiling of body fluids, and the impossibility of utilizing the ambient air for pressurization of the cabin.

Other static space equivalent conditions are the result of the appearance, in full force, of certain extraterrestrial factors such as cosmic rays, meteors, etc. These space equivalent conditions in the vicinity of the earth are affected by the solid body of the earth, its speed, and its magnetic field.

The state of zero-gravity as it is encountered in flight is defined as a *dynamic space equivalent condition.* This condition is not associated with any height or distance from the earth. Only its permanency requires a certain level above the earth's surface.



Credit: AIR FORCE PHOTO

Dr. Hubertus Strughold seated in the doorway of the space cabin simulator of the USAF School of Aviation Medicine, Randolph AFB, Texas.

The concept of space equivalence clearly shows us, where we stand today in the advancement of flight. With regard to manned rocket-powered craft, we are in the phase of *partial space equivalence,* where one or several—but not yet all—space equivalent conditions are encountered. Unmanned rockets have penetrated deep into the region of *total space equivalence* which for all practical purposes begins above 120 miles, if we ignore some minor variations caused by the vicinity of the earth.

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THE MEN *and the Machines*

PART V

Air Operations in World War I

About one year was required after the United States of America had declared war on the Central Powers before American air strength of any measurable degree could be brought to bear against the enemy. This was emblematic of the almost total state of unpreparedness of the U. S. for war. By midsummer of 1918, American air units began arriving in France in ever-increasing numbers, and by late summer of that year there were available sufficient units to plan large-scale offensives.

Provided a cushion of time by her Allies, America, as represented by her military leaders, was given the decided privilege and opportunity of studying warfare from the experience of both her Allies and her enemy, and to develop plans for the use of air power. As we have already seen, General William Mitchell emerged as the foremost American exponent of air power, largely because of his dashing and colorful personality, his confident character, and his audacity to propound and tenaciously adhere to new and novel concepts not ordinarily deemed possible by most of the military minds of the day. He was characterized as a fighting man, and liked to spend most of his days with the fighting units at the front.

Credit: NATIONAL ARCHIVES

Col. Edgar S. Gorrell, who submitted a plan and proposal for a bombing campaign to the Chief of Air Service, AEF, which became known as the "strategic" aviation plan, and later night bombardment, was regarded as one of the outstanding planners in World War I.

It is generally conceded that along with Mitchell, Col. Raynal C. Bolling and Col. Edgar S. Gorrell were largely instrumental for the organizational and operational concepts and plans. While it is much easier to single out these progenitors it is an almost impossible task to enumerate the long list of persons responsible for the actual organizational work and the actual implementation of the plans and concepts: Among these are the names of Gen. Mason Patrick, Gen. Benjamin D. Foulois, Gen. Frank P. Lahm, Col. T. DeWitt Milling, Col. Townsend F. Dodd, and a long list of many other enthusiastic air power supporters.

Tactics, Techniques, Concepts and Doctrines

At the time of our entry into the war, there were no clearly defined theories or doctrines on the use of air power, although the major European powers had gradually evolved doctrines and techniques, applicable to their particular situations. The British, French, Germans and Italians developed their separate theories. The British and Italian theories were generally more akin to each other in that each tried to stress the importance of the strategic concept of aerial warfare. The French and the Germans on the other hand maintained greater importance on closer support with the ground forces, artillery fire adjustment and aerial reconnaissance. In the U. S. the aircraft production program was geared substantially to the recommendations of the Bolling Mission of 1917.[1] Still other recommendations had been made by Gen. Billy Mitchell during his free-lance days in the early part of 1917.

The control of the air had become a recognized requisite early in the fighting stages of the air war. The mastery of the air changed hands rapidly and often painfully, until the Allies achieved final supremacy in the fall of 1918. As early as 1916 it had become evident to the strategists that it was highly advantageous to keep the enemy's aircraft out of the air insofar as it was possible. This was a continuing struggle. The Germans gained control of the air when Anthony Fokker developed the synchronized gear which enabled the Germans to fire their machine guns through rotating propellers. However, with the passage of time the Allies were able to improve the quality and the quantity

[1] *The Men and the Machines (Part IV)*, October 1957.

of their airplanes. In addition to this, through the development of superior tactics and techniques in aerial battles, formation flying and concentration of force, the Allies were able to gain supremacy of the air once again and were thus able to conduct raids behind the enemy lines. These shock raids plus the elements of initiative and surprise allowed the Allies to maintain possession of the skies in late summer and early fall of 1918, shortly before the war's end.

The evolution of techniques graduated from the colorful and exciting "dogfighting"—each man on his own—to the ultimate in mutual protection, formation flying with fighter cover and fighter escort. The largest number of heroes and aces were produced in the earlier phases of the war in the free-lance form of aerial fighting. This method of fighting shortly proved too costly, even for the Germans, whose ace, Baron von Richtofen had destroyed some 80 Allied aircraft, and who began using formation flying techniques for protection. Formation flying was not new or novel with the Germans, however. The Allies had begun formation flying as a measure of protection against the synchronized machine guns of the Germans in 1915. As the war progressed the size of the formations increased, but they were usually composed of the basic flight of five planes each, in "V's". This transition from individual tactics to formation tactics caused the emphasis shift from individuals to squadrons.

The War Department General Staff did eventually develop an overall air doctrine, of a sort. This office averred that from the standpoint of destruction, the function of the bombing plane was essentially the same as that of long-range artillery. Then by ignoring completely the factor of range, the General Staff reduced the bombers to the status of field guns and concluded that it took two squadrons of bombers to do the work of one 155mm. gun. On 5 November 1918, the Chief of Air Service reported on the General Staff findings. He further stated that there were three criteria for the composition of an air force; observation units in proportion to ground strength; pursuit forces in proportion to enemy strength; and bombardment in proportion to the nation's ability to produce. This statement coincided with the one made earlier by Col. Bolling.

Gen. Mitchell followed this with some tactical air doctrine which he summed up as follows:

> To find out where the hostile air force is, to concentrate on that point with our Pursuit, Attack and Bombardment Aviation, to obtain a decision over the hostile air force, and then to attack the enemy's armies on land or navies on the water, and obtain a decision over them.[2]

In the interest of economy and time, early attempts were made to develop one airplane that could do everything. But this gave way to specialization with the development of definite categories of offensive aviation—pursuit, attack, bombardment and observation. The latter was auxiliary to the other arms of the service. All of these categories, however, were more or less dependent on each other and interrelated. All air elements had to be constantly aware of positions and locations of friendly forces on the ground which demanded coordination in all air operations.

The doctrine and practice of observation flying developed simply and harmoniously; not so with attack, pursuit or bombardment aviation. The greatest development was, of course, in

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[2] Mitchell, Brig. Gen. William, *Our Air Force*, N. Y., E. P. Dutton & Co. Inc., 1921, p. 15.

pursuit which changed the whole structure of fighting for the control of the air.

Attack aviation developed late in the war and Allied attack missions were incidental to the regular activities of pursuit and bombardment. No special attack planes were built by the Americans, although Billy Mitchell did envision one, designed specifically for that purpose. The Germans had a Junkers plane designed especially for strafing purposes.

Bombardment Aviation

Bombardment aviation was divided into two categories, tactical and strategic. Tactical bombardment aviation involved daylight raids over the battlefields, while strategic bombardment aviation consisted of night operations, supposedly with bombers carrying heavy destructive loads. This latter type of operations was not truly "strategic" in the sense that strategic aviation was employed in World War II, but the ground work for the strategic theory was laid in World War I. American air forces did no real strategic bombing in World War I for two reasons: the failure to produce any long-range bombers capable of carrying a destructive load; and, the opposition of GHQ to any substantial strategic diversion.

The Germans employed "strategic" bombardment against the larger cities such as Paris and London. The civilian population always suffered more casualties than the military, but the objectives of German bombing were to compel England to retain a large part of her fighting air force at home for defense and, to directly affect the morale of the people. These bombing raids against England resulted in the creation of the Prime Minister's Committee on Air Organization and Home Defence Against Air Raids, which under Jan Christian Smuts, produced what has later become known as the "Magna Carta" for air power. On 17 August 1917, the Smuts Board recommended the creation of the Royal Air Force on a coequal status with that of the British Army and the Royal Navy.

Zeppelin raids started on London in October, 1915. These raids were brought to an abrupt ending in October 1917 when improved British fighters and interceptors were able to force the Zeppelins to go above their operational ceilings to avoid interception and attack. On the final Zeppelin raid over London, five of the eleven airships participating lost so much of their lifting gas in getting to those excessive altitudes that they were forced, through the excess loss of lift, to make crash landings and were destroyed. Weather and adverse winds forced at least two of the ships to crash land short of their home bases, but these were minor contributing factors. The Zeppelin was outmoded by the fighter-interceptor.

In turn the Allies retaliated by bombing German towns and cities near the Rhine River. Although, in the main, these attacks were diversionary, they were successful to the degree that the German people complained so vociferously that reprisals for bombing became a deterrent factor, albeit a small one.

British Theories and Influence

Winston Churchill early became one of the influencing factors in the development of the Royal Air Force. As early as Oct. 1917, he had advocated the bombing of enemy bases and communications, but he maintained that these attacks should be related to the main battle.[3] He thought at the time

[3] Churchill, Winston S., "Munitions Possibilities of 1918," Extract from paper dated 21 Oct. 1917, *The Air Power Historian*, July 1956, p. 157.

that it was improbable that "any terrorization of the civil population which could be achieved by air attack would compel the government of a great nation to surrender." The direct object of an air offensive was to deprive the German armies on the western front of their capacity for resistance. Many of Churchill's ideas were geared and harnessed to the support of infantry as the primary objective of air power. However, Churchill could and did see farther than most of the people of his day, and he felt that there was an inherent capability and possibility in the use of air power, and that the airplane could be used to destroy enemy lines of communication and enemy bases. He even envisioned the delivery of huge armadas of ground troops via air bridges to focal points of ground warfare, once mastery of the air was obtained.

Under the influence of Churchill, the Smuts Board, and at the urgings of General Hugh "Boom" Trenchard, the British established in the field on 5 June 1918, an Independent Air Force. The initial mission of this organization was to bomb the German heartland and German industrial systems. In actuality, however, about 50% of its initial operations had to be directed against enemy airdromes as a measure of self-protection; because of this plus the fact that long-range aircraft never became available, the Independent Air Force never really had the opportunity to prove itself, before the war ended.

Italian Theories and Influence

Gianni Caproni, the Italian inventor and builder, was one of the early advocates of strategic bombing.[4] His close association with another outstanding visionary and advocate of air power, Giulio Douhet, prompted some outstanding reasoning and laid the foundation for many of the theories which later were developed by the Allies. Caproni exerted a tremendous influence on the Bolling Mission, and particularly on Col. Edgar S. Gorrell, and Lt. Col. Virginius E. Clark.

In 1917, Caproni had recommended to President Raymond Poincare' of France that the Allies use three-engined bombers against enemy convoys, submarine bases, industrial centers and free towns. He further advocated the building of more and bigger bombers and the use of night bombers for attacks against enemy airfields, aircraft plants, transportation targets, railroad junctions, stations, bridges, ports and fleets.

In his memorandum on "Air War" for the U. S. Air Service, Caproni stated that bombing planes were better than artillery because they had greater range and flexibility. From a political point of view aviation was more important than any other instrument of war because it could operate inside enemy territory, and it could operate in densely populated areas where low morale and depression could provoke the most dangerous results.

Mitchell

The British General Trenchard was able to influence the views of Gen. Billy Mitchell probably more than any other individual. Mitchell fully supported Trenchard's thinking that the airplane was an offensive weapon and not a defensive one, and that the only way to handle air power properly was to unify it under one major command. From retrospect, study shows that many of the tactics developed and used during World War I, and following, can be attributed directly to the influ-

[4] Atkinson, Dr. J. L. Boone, "Italian Influence on the Origins of the American Concept of Strategic Bombardment," *The Air Power Historian*, July, 1957, p. 141.

ence and inspiration of Mitchell. He instigated and encouraged dive bombing in echelon, massed ground attacks and even an operations warning net. He was convinced of the value of strategic bombing and advocated tight formations and the use of fighter escort protection for bombers.

This latter strategem is particularly important because when America first entered the war, the prevalent thinking was that pursuit escort would not be necessary for bomber formations. This very same attitude prevailed and the same arguments used and expounded by many of the foremost planners for air, in World War II.

At Chateau-Thierry there were practically no bombers. Bomber planes became available later, and were used in the battle of St. Mihiel. It was learned here that tight formations alone, of and by themselves, did not prevent heavy loss of bombers. After which it was decided that pursuit escort of some sort was mandatory and as a consequence, pursuit aircraft began arriving over the bombing targets a few minutes ahead of the bombers and then waited in the immediate vicinity to escort the bombers home, in the late battles of the air war. Bomber losses, as a result of this action, decreased immediately.

Under Mitchell's guidance, whenever an operation against the enemy was projected, the information was usually contained in a plan of operations or employment drawn up by the commander of the air forces, submitted to the commanding general of all forces, and published in the form of orders by headquarters.[5] The plan of employment usually provided for three stages of operations; preparatory, attack and exploitation. In the preparatory stage it was necessary to find out everything possible about the enemy by reconnaissance, photographic and visual. In the attack phase the air forces attempted to destroy the hostile air forces and its airdromes. This required penetration of the enemy lines as well as pursuit patrols for friendly troop protection. In the exploitation phase, bombardment planes attacked the most profit producing enemy targets, which might be concentration of supplies, communications lines, transportation centers, railroad junctions, bridges, ammunition depots and cities converted to military use. Bomber raids were generally protected by pursuit aircraft. Attack aircraft facilitated the advance of ground troops by knocking out everything in front of them that could be attacked from the air.

Near the end of the war, Mitchell had planned to use 60 squadrons of Handley-Page bombers as troop carriers, carrying 10 men to a plane, not counting the crew of two. These airborne soldiers were to be dropped by parachute behind enemy lines, and the bombers were to be accompanied by heavily armored attack and pursuit planes. The attack planes were to cause diversionary attention ahead of the bomber formation of troop carriers, while the fighters were to provide immediate support and protection. The idea, as originally conceived, was to attack a target on both flanks with the airborne soldiers. Mitchell knew it would not be possible to assemble and immediately organize into fighting units all the airlifted platoons, but he felt that a sufficient percentage of them could overcome most of the enemy resistance, in the wake of preceding bomber and fighter attacks. This plan, like so many others, was never

[5] Mitchell, Brig. Gen. William, *Our Air Force*, New York, E. P. Dutton & Co., Inc., pp. 38-44.

Credit: NATIONAL ARCHIVES

The Sopwith Camel, built by the British, was one of the most popular Allied fighter-pursuit type aircraft of WWI. It was in this type of aircraft that Capt. Elliot W. Springs and other members of the 148th Squadron, attached to the British Expeditionary Force, became aces.

implemented because the war ended before the aircraft became available.

The concepts of air power which Mitchell formed during World War I consisted of several axioms which he never forgot or caused to be forgotten. These were: the only defense against aircraft is other aircraft; the airplane is a defensive weapon and not a offensive one; there must be unified air command; it is necessary to establish air superiority over the battle area in order to win the battle and force must be concentrated. The fact that he was able to prove to a large degree the validity of these concepts during actual war led, more or less, to their adoption as principles of air warfare.

Gorrell

As a member of the Bolling Mission, Lt. Col. Edgar S. Gorrell was affected and highly influenced toward the strategic concept of aerial bombing. Whether he had developed his own thesis on the use of the airplanes for bombing purposes earlier, is not definitely known, but he did become a staunch advocate as a result of his part in the Mission and his many talks and meetings with Caproni of Italy. By mid-1917 Mitchell had already been somewhat successful in influencing the AEF Staff to provide more emphasis on air power, and the organization of air forces within the AEF. Later, on 28 November 1917, Gorrell submitted

a bombing campaign proposal to the Chiefs of Air Service. In it he indicated that the Germans were concentrating on building Gotha bombers to be supplemented by pursuit planes (following the demise of the Zeppelin). To this end he reported:

> Judging by the character of airplanes Germany is building for the bomb-dropping together with the realization both sides have apparently come to—namely that to affect the armies in the fields it is necessary to affect the manufacturing output of the countries—we can readily see that next spring and next summer the Allies will be visited by bomb-dropping airplanes both by day and night and will be confronted with the enemy's superiority in the air and with a bomb-dropping campaign against them that will tend to wreck their commercial centers—to say nothing of the moral effect of such bomb-dropping against the inhabitants of the Allied countries.[6]

On December 3, 1917, Gorrell was put in charge of Strategical Aviation, Zone of Advance, AEF. This section later became known as the Night Bombardment Section. Gorrell appointed Maj. Harold Fowler as his Executive Officer and Major Millard F. Harmon was put in charge of Plans, Strategical Air Service. Wing Commander Spencer Gray, Royal Naval Air Service was also put on the staff.

Gorrell proposed that the Allies adopt a bombing project immediately which would include the bombing of chemical factories to decrease the output of German shells, and hitting the Mercedes engine plants and the Bosch magneto factories in Stuttgart. He divided bombing, once again, into two categories, tactical and strategical. He wanted to direct the strategic bombing forces against the commercial centers of Germany, which he divided into four industrial groups.

He advocated operating out of bases in the Verdun-Toul sector for this would enable more planes to reach a greater variety of targets, thus keeping the Germans off their stride in their defenses. He further advocated the use of night as well as day bombers, for he insisted that the Germans should not be given the opportunity for making repairs on damaged targets. Because night bombers were not available, however, day bombing was stressed. In the planning stages he emphasized the necessity for training in bomber operations, the study of meteorology, an increase of bomb production, an educated program for the packaging and handling of bombs, the locations and types of shelters for the airmen, and the location and marking of various fields.

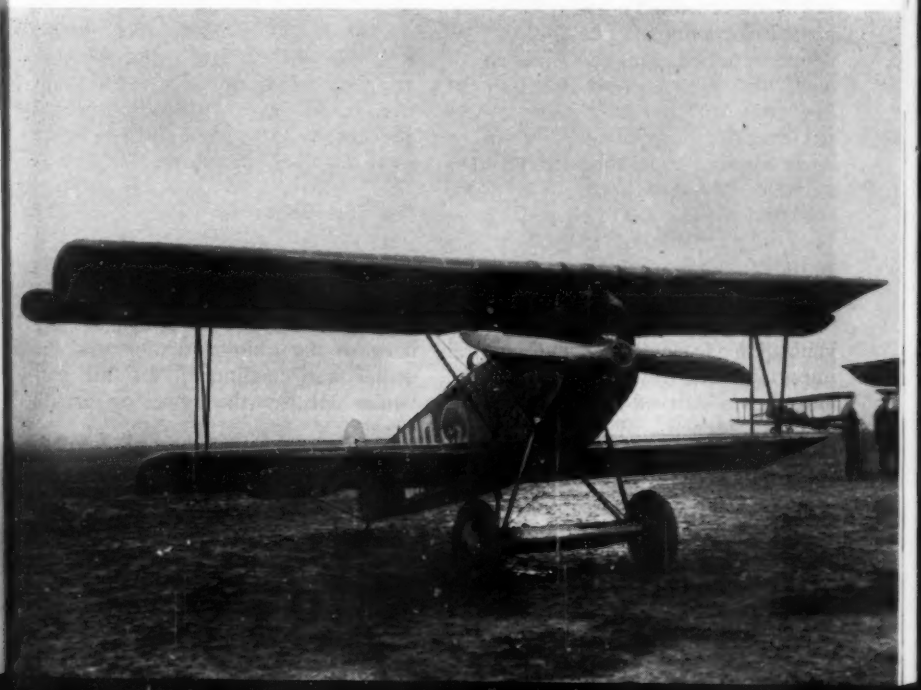
Gorrell believed in the concentration of force against a single target. He suggested that planes attack different targets on different days, in order to hamper enemy defenses and to instill fear in the minds of those not yet attacked. He felt also that concentrated bombing on a target over a period of several hours would almost destroy any target, and he argued that the fires which would be started would be out of proportion to the immediate effects of the bombs themselves.

In presenting his arguments, Gorrell pointed out that artillery had shelled Germany for three years up to that time, with an enormous loss of life and had gained only an insignificant number of miles along the front. He felt that a similar expenditure of money, material, and personnel on aerial bom-

[6] Gorrell, Col. E. S., "Early History of the Strategical Section, Air Service," *History of the Air Service, AEF*, Vol. B6, p. 372.

Credit: FOKKER, NATIONAL ARCHIVES
ALBATROSS, AIR FORCE

The Fokker D VII and the Albatross de Chasse were two of Germany's most frequently used fighter planes of WWI. The Albatross was a powerful airplane for its day but was rather sluggish on the controls and therefore not too good in a "dog fight." The Fokker on the other hand was one of the war's most maneuverable planes and in one month German pilots shot down 565 Allied planes with this model (see below).



bardment would end the war much sooner, with a lot less loss of life.

During the Christmas holidays in 1917, Gen. Trenchard proposed that American bombing forces be placed under his command so that they could profit from the British experience, and later, as American forces grew, they could form their own command under the overall command of the British Commander. This never occurred because of General Pershing's reluctance to parcel out American units.

In the summer of 1918, the British Independent Air Force, under Gen. Trenchard, operated as a strategic force under instructions issued directly by the British Air Ministry. For this reason it was decided on 18 June 1918, by the Chief of Staff, AEF, that the American bombardment air forces would remain an integral part of the AEF; no independent operations would take place.

By the fall of 1918 there had come about a gradual change in the thinking of military minds. France had accepted the principles behind the Independent Air Force, and America became willing to join her Allies in the formation of an Inter-Allied Independent Air Force to be directed by Trenchard but under the supreme command of Marshall Foch. This force was to be equipped with long-range bombers, capable of striking at the heart of Berlin, but the war ended before the planes became available.

Meanwhile the original strategic organization itself underwent several important changes. In Jan. 1918, Gorrell was relieved and succeeded by Col. A. Monell. Wing Commander Gray later became discouraged over the failure of American production and returned to his own forces. The name was changed to GHQ Air Service Reserve in the summer of 1918, and bombardment aviation remained as an arm of the Army, designed to be used with and in coordination with the entire AEF structure in Europe.

In his summary report, Col. Gorrell reported that he felt that the chief difficulties with the strategic bombing campaign were that it was too optimistic and that it had not been approved by GHQ. America had failed to produce the long-range bombers, and it was proven once again, all too late, that money and men do not make an air force overnight, and that the time to prepare was before and not after war was declared.

Operations [7]

As has been pointed out earlier in this narrative, most Americans trained and operated in France, alone or with the French, or with the British. A few Americans trained and flew with the Italians. The 1st Aero Squadron[8], which was the first wholly intact American squadron, did not arrive in France until 3 Sept. 1917, under the command of Major Ralph Royce. Lt. Arthur J. Coyle was the first member of the squadron to engage in a combat mission, on 12 April, 1918, when he was attacked by three enemy planes in the Toul sector of operations.

The Toul Sector

The Toul Sector had been selected as the area where the Americans would be stationed to obtain the necessary experience that would bridge the gap between the training schools and the actual war conditions. In this particular locality the opposing armies

[7] For an account of the first American fighting forces, The Lafayette Escadrille, see the July issue of *The Air Power Historian*, 1957.

[8] Maurer, Dr. Maurer, "The 1st Aero Squadron," *The Air Power Historian*, October, 1957, p. 207.

Credit: AIR FORCE

Some Americans were fighting in the war in Europe as early as 1915, long before the official American declaration of war. Most of the air-minded fighters were with the Lafayette Escadrille. The most famous personality to emerge from the Escadrille was Raoul "Luf" Lufbery, shown here on the right. The others are left to right: Commandant Féquant, Commandant of Groupe de Combat 13 of which the Escadrille was part, Capt. Thénault, commanding officer of the Lafayette Escadrille and "Bill" Thaw, one of the original flying members of the squadron, and later an American Lt. Colonel.

were facing each other in two well defined positions, and since the early days of the war this had been a comparatively quiet sector, with both sides using it as rest area and as a position to be held by tired or inexperienced troops.

The 91st Observation Squadron, one

of America's first, began operations in this Toul sector on 6 June 1918, under the command of Major John N. Reynolds. Day Bombardment squadrons also got started here when the 96th became the first squadron to carry bombs over enemy lines, after their assignment to Amanty on 18 May 1918.[9]

The Toul Sector was used as a practice grounds for the first American pursuit squadrons. The 95th was the first American pursuit squadron to arrive in France, but it was not immediately equipped with planes. Capt. James E. Miller, then commanding the 95th, Major Davenport Johnson and Major Millard F. Harmon flew the first unofficial pursuit mission in early March 1918, in which Capt. Miller was killed and Maj. Harmon had been forced to return to his starting base because of engine trouble. The first official patrol, however, took place on 15 March, 1918, by three pilots of the 95th in unarmed Nieuports.

After the pilots of the 95th were ordered to training in aerial gunnery, the 94th Squadron moved into the Gengault airdrome, near Toul, and this organization claims the distinction of being the first American organized and trained pursuit squadron to see active service, as a unit, on the front, when they began sustained operations on 14 April, 1918. On that day, Lt. Alan F. Winslow and Lt. Douglas Campbell each shot down one enemy plane. Subsequently, Lt. Campbell became the first American ace, but was shortly thereafter ordered back to the U. S. Lt. Edward V. Rickenbacker, who later became commanding officer of the 94th, became the second American ace, and eventually, the American ace of aces with 25 confirmed victories.[10]

On May 19th, 1918, Major Raoul Lufberry, then commanding the 94th, after his transfer from the Lafayette Escadrille, was killed when he fell from a burning plane. He was not wearing a parachute. With the Escadrille he had downed 17 German planes, but this record is not shown on the official American records. He is credited with coaching Rickenbacker in the art of dog fighting against the Germans.

The 94th likewise claims the distinction of being the last squadron to officially shoot down a German plane, when Maj. Maxwell Kirby downed a German on 10 Nov. 1918.

In May, three other pursuit squadrons were ready to be sent to the front and the 1st Pursuit Group was formed of the 94th, 95th, 27th and the 147th. Some of the pilots of each of these squadrons had served with the Escadrille, and their experience and guidance were invaluable.

The Toul Sector was also used for the development of American balloon companies, with the 2d Balloon Company being the first American Air Service unit to join the combat forces of the 1st Division.

Chateau-Thierry Campaign

On the night of 14/15 July 1918 began what turned out to be a major offensive, in the river Marne area. On this date (then Col.), Billy Mitchell, who was at the time in charge of aviation on the front, had discussed the importance of a reconnaissance patrol, for the Allies had gotten wind of a portending German offensive. He himself made the patrol flight just before dawn of the 15th. East of Dormans

[9] See Hopper, Bruce, "American Day Bombardment in World War I," *The Air Power Historian*, April, 1957, p. 87.

[10] Almost all reference sources credit Rickenbacker with 26 victories; however, the official Air Force files have his record at 25.

he saw German troops pouring across five new pontoon bridges, where earlier the regular bridges had been destroyed. Mitchell immediately proposed an air attack against the enemy's great supply base at Fere-en-Tardenois. The plan was approved and implemented with the use of some British bombers and with four squadrons of the 1st Pursuit Group. Despite the strong resistance on the part of the Germans, the Allies were able to manage a victory, although costly, and this represented the first combined offensive action. The mission helped contain the German airplanes within a confined area rather than allowing them the opportunity to fight with their ground forces on the immediate battle line. This was an important lesson.

The American ground forces were able to move by night, under the thrust and parry and diversionary action of the air forces, which misled the Germans, who later retreated from the salient. Because of this proven initiative and resourcefulness on the part of the Americans, with their limited number of aircraft, Gen. Pershing was able to convince his skeptics that there should be a separate American Army.

On 18 July, the Allies began their own counteroffensive in that area. The 1st Pursuit Group, which had moved to Ormeaux with 52 airplanes early in July, moved again to Saints, all the while continuing their operational flying. For two weeks after the beginning of the counteroffensive the 1st Pursuit Group worked almost continuously and during this time they even changed from Nieuport aircraft to Spad type aircraft.

As the ground forces moved further north, the Air Service moved its fields closer to the fighting front, which extended the supply lines and supplies became a major problem. In addition, many pilots were lost for combat service because of unfamiliarity with the new fields, emergency landing strips, and the frequent necessity for landing after dark, without proper facilities. It was during this period that ground commanders began harassing group commanders with telephone calls for information and orders all day long. It was never really understood whether the 1st Brigade's duty was tactical or administrative, although Mitchell, who was in charge, maintained that it was both.

Credit: NATIONAL ARCHIVES

Flying Sopwith Camels with the 148th Squadron, attached to the BEF, Capt. Elliot W. Springs of Lancaster, South Carolina, was fourth ranking ace, on the official American rosters, with 12 victories over German aircraft. He was tied with Capt. Reed Landis of Illinois for this honor. He was also one of the few especially honored Distinguished Service Military Aviators of WWI.

St. Mihiel Campaign

There was a brief period of respite between Chateau-Thierry and St. Mihiel, and during this time, General Patrick placed all American air units along the French front under the Air Service, 1st Army, with Mitchell in command. These units had increased numerically, and Mitchell organized them along the same pattern of organization which the French had been using—pursuit, observation and bombardment. Most of the bomber groups and some of the observation and pursuit groups were French. In all, the Air Service, 1st Army, had 49 squadrons of which about half were American. Mitchell managed to mass most of his strength behind an 80 mile front manned by American and French soldiers under General Pershing.

This new organization began to function on 10 August 1918, on the same day that the 1st Army began its operations in the St. Mihiel salient, which had been a thorn in the side of the French forces for four years. Headquarters for this new organization moved to Neuchateau where plans for the offensive were readied. It later moved to Souilly, on 21 Sept. 1918, where it remained until the end of the war.

On 28 August, Col. T. DeWitt Milling was appointed Chief of Staff; Commandant Paul Armengaud, Chief of the French Mission attached to the Air Service, 1st Army, was appointed Asst. Chief of Staff. An Information Section was established under Lt. Col. T. F. Dodd, and a Balloon Section was added under Major John A. Paegelow.

Two of the American pursuit squadrons, the 17th and the 148th, were serving with the British Expeditionary Forces, having received a large part of their training and experience under the Canadians and the British.

Altogether, Mitchell had under his command 701 pursuit planes, 366 observation planes, 323 day bombardment planes, and 91 night bombardment planes, or a total of 1,481 airplanes, which was "the largest aggregation of air forces that had ever been engaged in one operation on the western front at any time during the entire progress of the war."[11] Before the actual attack on the morning of the 12th of Sept., the Air Service managed to limit enemy reconnaissance and at the same time succeeded in collecting valuable information behind enemy lines, such as terrain features, concentrations of batteries, troops, etc., without arousing undue suspicion in the minds of the enemy concerning the massing of Allied air strength and the forthcoming offensive. The Germans in the meantime, had moved some of their better flying units from other sections of the front into the area. Mitchell knew that he would have to take the offensive and maintain air supremacy over the area in order to be successful. He used his forces in about the same way that he did at Chateau-Thierry. About one-third of his force, or about 500 planes were committed to ground support; the rest either simultaneously or alternately attacked the opposite flanks of the salient and its primary bases.

Following the success in the air, the Allies advanced along almost the entire length of the front, during the rest of the month of September, thus giving encouragement to another major offensive, in the Meuse-Argonne sector of France.

It was in the St. Mihiel campaign that Lt. Frank Luke achieved his notoriety and fame as an ace and as a

[11] Pershing, General John J., "Final Report," Government Printing Office, 1919, p. 42.

Credit: NATIONAL ARCHIVES

Ranking second only to Rickenbacker as the leading American ace of WWI, Lt. Frank Luke, Jr., was credited with 18 victories. Most of his victories were achieved against balloons, however. He was killed fighting a one man war and became the first airman to receive the Congressional Medal of Honor. Luke Air Force Base in Arizona is named in his honor.

"balloon buster." Altogether, the 1st Pursuit Group shot down so many balloons during this period that the enemy was able to obtain only meager information from this source. It was Luke, together with Lt. Joe Wehner, both of the 27th Squadron, who conceived the idea of striking at balloons just at dawn and at dusk, before the enemy observers could get into action. Luke shot down 18 enemy craft in a period of 17 days. On 18 Sept., he brought down three enemy planes and two balloons in a period of ten minutes. On 29 Sept., after downing three enemy balloons, avenging the death of his partner, Wehner, who was killed saving Luke's life, he was chased by eight German planes. He flew to within about 150 feet of the ground and opened fire on the German ground troops, killing at least six of them, and wounding many others. He was forced to crash behind the enemy lines; surrounded by the enemy troops he managed to hold them off with his pistol, inflicting casualties, until he himself was finally killed. He became the first recipient of the Congressional Medal of Honor, awarded posthumously.

Meuse-Argonne Offensive

At the completion of the St. Mihiel campaign, the American forces had gained enough experience to be considered a well organized combat outfit. From the 14th to the 16th of September, the bulk of the American Army was transferred to the sector facing the Meuse-Argonne area for a planned offensive. Air units moved simultaneously, and quite secretly, all the while continuing their patrol and umbrella operations, preventing enemy observation planes from securing much information about the move and the planned offensive. Also during this period, the Air Service engaged in training in those areas of experienced deficiencies, which had been noted during the St. Mihiel operations, including closer cooperation with the ground forces.

Mitchell entered this final campaign with a much smaller force of aircraft than he had at St. Mihiel. His initial strength was about 800 planes, but of these about 600 were American. The French had withdrawn most of their forces. Mitchell opened the offensive on 26 Sept. with a three hour aerial barrage in preparation for the American ground assault.

As before, Mitchell concentrated his large forces for single blows at the

enemy rather than parceling out his strength to divisions and corps. By incessant attacks on the enemy rear areas he was able, to a large extent, to forestall German counter-attacks.

Bombers played a key role in establishing air superiority this time. The Germans had come to fear the bombers and bomber attacks and consequently threw up large countering forces which usually resulted in the biggest air battles of the war. One of the largest bombing forces of this offensive happened on 9 Oct. 1918, when more than 200 bombers, 100 pursuit planes and 53 tri-place machines conducted an operation in full view of the ground troops and attacked an enemy concentration point between LaWavrille and Damvilliers, where the Germans were forming for a counter-attack. More than 30 tons of bombs were dropped while the enemy force was forming for the counter-attack. During this engagement twelve enemy planes were shot down while only one Allied plane failed to return. Mitchell stated that in the 24 hour period of that day, 69 tons of bombs were dropped on all enemy targets, making it a record for WWI in terms of bomb tonnage.

During this period of the decline of opposing air strength, pursuit aviation forces engaged primarily in offensive shock patrols and in protective patrols for both bombers and observation type aircraft. Large concentrations of pursuit, consisting of several formations, echeloned in depth, were employed in the Meuse-Argonne operations and excellent results were obtained with a minimum expenditure of machines and personnel. Also by this time, the American Army, and especially the ground troops, began to recognize the importance of our superiority in the air-to-surface operations, and a closer spirit of harmony developed between the air and ground forces. In fact, the use of the airplane to gain local air supremacy before any of the battles became a normal procedure. Allied air superiority made these local objectives possible.

The observation squadrons were far more successful in this campaign than they had been at any time heretofore. They defended themselves better, adopted aggressive tactics against enemy machine gun emplacements and other strong points and were able to effect better adjustments of artillery fire. In this work, the balloon squadrons, of which there were now 23 at the front, also played an important role.

An interesting venture in aerial warfare in WWI was the distribution of leaflets and propaganda folders, whose purpose was to contribute to the general demoralization of enemy morale and, in specific sectors, to break the fighting spirit of particular units and to bring about desertions at critical times. The arguments propounded by the propaganda leaflets were the same as those used during WWII—good treatment of prisoners, self-preservation and the inevitable defeat of Germany.

Conclusion

When the Armistice was signed on 11 November 1918, the total Air Service strength was about 20,000 officers and 175,000 enlisted men. The 740 American planes in squadrons at the time of the Armistice contributed only a little more than ten percent of the total Allied air strength of the war. The American Air Service conducted 150 separate air raids, dropping about 138 tons of bombs and penetrated as far as about 160 miles behind the enemy lines. They lost 289 planes

and 48 balloons, including 57 planes piloted by Americans flying with the British, French and Italians. American planes were credited with 781 enemy aircraft and 73 enemy balloons. Of the 1,233 Air Service casualties in France, 164 were killed in action, 319 were killed in accidents, 335 died of other causes, about 200 were missing in action, about 102 taken prisoners and about 113 were wounded. It is generally agreed that many of the pilots who were killed might have saved their lives if they had used parachutes, but there existed a stubborn refusal among the pilots to do so. On the other hand, German pilots were using chutes by the closing stages of the war.

In the "Golden Age" of aerial fighting and individual aerial combat, the United States has honored over 75 pilots as aces—five or more kills.

A number of early fliers who had been on duty in the Aviation Section on or before 18 July 1914 were given the rating of Military Aviator in 1917 and 1918. A number of officers also received the ratings of Junior Military Aviators and Military Aviators for distinguished service. Those who were rated Military Aviators in this manner received 75% increase in their pay as long as they remained in the Air Service.

(This narrative was prepared by Major Carman P. Felice, Military Liaison Officer with The Air Force Historical Foundation, from data extracted from "The U. S. Army Air Service in World War I," official historical study by the USAF Historical Division, Research Studies Institute, Maxwell AFB, Ala. (1)

This picture of a Spad, with the insignia of the 2d Pursuit Group, shows a model XIII, which was one of the most popular pursuits of the war and was very versatile. There were several production models of the Spad. In our October issue, we mistakenly characterized the model XVI as very maneuverable, which it was not, being primarily an observation type model. The models X and XIII were the very maneuverable models.

Credit: NATIONAL ARCHIVES

The Ugly Duckling of Air Power

By COLONEL JOHN A. McCANN, USAF

"Can you lay eggs?" She (the hen) asked of the duckling.

"No."

"Well, then, hold your tongue, will you!" and the cat asked:

"Can you arch your back or purr or give out sparks?"

"No."

"Well, then, your opinion's not wanted, when sensible people are talking."

It has long been conceded that the principal value of Allied forces in the China-India-Burma area during World War II was to dissipate Japanese air and ground strength on its western flank, provide a military barrier to possible Jap-German link-up through India, and finally to encourage continued Chinese resistance to the invaders of their homeland. In this primitive coliseum of war which made its contribution to the catechism of modern air power, the C-47 and its transport companions played a vital and effective role. One of the officers closely identified with U.S. Troop Carrier operations in this area from 1943 to the end of the war brings to light a little known and rarely told exploit of the versatile C-47 and the airmen who participated.

Colonel John A. McCann is the Air War College Deputy for Extension Courses. He received his B.S. and M.A. from Miami University, Oxford, Ohio and entered the U.S. Air Corps as a 1st Lieutenant in 1942 from the investment banking business to which he returned in 1946. He was recalled to active duty in October 1950 with his Reserve unit, the 433rd Troop Carrier Wing of Cleveland, Ohio. A graduate of the 1952 Class of the Air War College, Col. McCann served four years in Europe with Headquarters, USEUCOM prior to his return to Maxwell as a member of the Air War College Faculty.

As war stories start to flow at any gathering of veteran airmen, the transport enthusiast is generally in the same predicament as the Ugly Duckling. The lads who earned their Air Medals under fire over Ploesti, Schweinfurt, Rabaul, Tokyo and Rangoon are seldom prone to turn their talk to the drab affairs of the "gooney bird." The tangy flavor of the zooming P-51's and "Jugs," of Messerschmitts, or MIG's proves far more attractive to verbal appetites than the seemingly bland porridge of the C-47.

But the C-47 like the Ugly Duckling had its moments in warfare too. One of these incidents when the Ugly Duckling of Air Power "gave out sparks" deserves mention. The sole mention of this exploit in the vast and comprehensive Air Force Historical Archives lies buried in a single Group History

sentence: "The work of arming the rest of the C-47's continues."

This "Group History" is that of the 443rd Troop Carrier Group whose 1st, 2nd, 27th and 315th Squadrons formed the backbone of the 1944 airlift support of British Brigadier Wingate's Chindit penetration into Japanese held Burma. These outfits also prominently contributed to the relief of the beleaguered and surrounded British Garrison at Imphal in 1944 and flew all the aerial supply effort for Stilwell's troops in 1944 and 1945, including Merrill's Marauders, as they drove the Japs from Northern Burma south to Mandalay.

Commanding the 443rd was Colonel Charles D. Farr, an Army "brat" of Fort Riley who became a Navy enlisted pilot on the old *Saratoga* after a tour of duty as an aviation mechanic. Following his honorable discharge he was a barnstormer and crop duster until he reported to the Air Corps at Maxwell as duty pilot and Assistant Air Installations Officer in 1940. It was "Charley" Farr who effectively reacted, because of unrequited appeals for fighter cover to protect his unarmed C-47 crews when personnel casualties over the drop zones from enemy ground fire began to increase sharply.

Post-war education has done much to bring about a better appreciation of the overriding requirement to gain and maintain air superiority as the first and primary mission of air forces in a Theater of Operation. It is very often a job accomplished beyond eye shot of many of those who have legitimate claims for support of this same air power but have claims of lower priority. The "Kicker Crews" of the Troop Carriers and those concerned with their effectiveness, suffered from the same myopic view as their "ground pounder" colleagues when they were harrassed by enemy ground fire. In their view, fighters, who were busy elsewhere, should have rectified their local situation with highest priority. To aggravate this condition, 10th Air Force actually had very meagre fighter capabilities at the time. Transport teams were poor prospects indeed for suppressive support from this source, a fact which Colonel Farr soon came to appreciate.

Why Arm C-47's?

In making a drop to Allied ground forces engaging the Japs, it was necessary to parachute or free fall supplies in as close to them as possible. It was the responsibility of the ground forces to select their own DZ's (drop zones). This they did in a manner calculated to minimize further ground transportation of supplies to users and to maximize recovery of materials dropped. Large cloth panels marking the desired drop areas were usually in closest proximity to the zone of the fire fight. This frequently required pilots, when coming out of their shallow dive at under 400 feet, the altitude at which they made the drop to assure accuracy onto the pinpoint DZ areas, to overfly the Jap lines as they made recovery. They repeated this maneuver in an eliptical pattern of 8 to 10 passes, which was usually required to debouch their normal 6,000 pounds of drop cargo.

During the recovery stage, planes regained momentum slowly from their speed of about 110 mph. At this speed and altitude, the C-47 was virtually a "sitting duck" for Jap small arms fire to which it was frequently subjected. The usual Jap infantry man, accustomed to firing at stationary objects on the ground, normally aimed at the cockpit and, with alarming frequency, managed to kill or wound members of the kicker crew off-load-

ing at the door about 20 feet to the rear.

Colonel Farr believed that if a "gun" ship or ships were fed into these drop patterns, particularly in those areas where high volume of delivery was being affected and where we usually drew a volume of fire, that a good spray job from Cal. 50's would suppress hostile ground action against the aircraft.

"Mac," Colonel Farr said to me one rainy night in April 1944 as we sat on the creaky wicker chairs in our basha, nestled between two large revetments at Sylhet, India, "You're an aerial gunner—why can't we put calibre 50's on a C-47?"

I'd known Charley only a short time, but well enough to appreciate that he had a real "hen on" and he wanted to bat the idea around, even though he likely already had it well conceived in his own mind. So I asked, "Where—in the nose?" "Nope—too much stuff to fool with out there." He thought some more then said, "If we made a rig, could you shoot it out of the side window?" "Mebbe," I replied, "but you wouldn't get much area of fire and it would take up a lot of valuable room right in the middle of the cargo compartment." Then he said, "You're probably right—how about out the door?" "That's it," he continued, "Sure, we can rig up a tripod and cut a hole in the aft part of the cargo door."

"You mean mount a flexible fifty and fire it out of the door without any safety stops—Charley, the pilots would never sit still for that." "Oh yes they would," he answered, "Besides let's not cross that bridge yet."

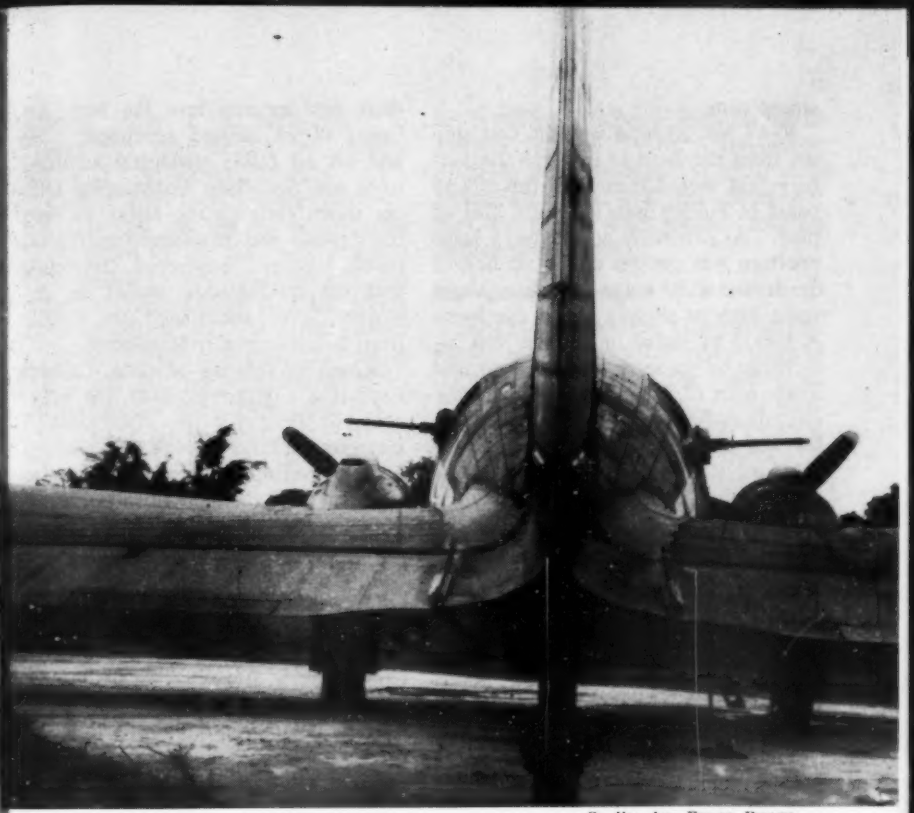
We "chalk talked" the details with pencil and paper until the Colonel had a workable sketch drawn up which he turned over to the maintenance gang the next day. The project was launched.

The 443rd Troop Carrier Group organized at Sylhet, India was created primarily to provide a coordinating outfit for the U.S. cargo outfits which had lately been joined with two British Cargo Squadrons to support Wingate. Troop Carrier Command, under U.S. Brig. General Don Old, who pioneered the "Hump" route, was the next higher joint U.S.-British headquarters which served to carry out the Allied plans and policies of the South East Asia Command headed by Lord Louis Mountbatten. Major General George B. Stratemeyer was the head Allied Air Officer.

In order to bring the 443rd up to the traditional U.S. standards for a Group strength of four squadrons, the 1st at Sookerating and the 2nd at Dinjan were commandeered for cadre personnel of officers and non-coms to form an additional Squadron—the 315th. Casuals and replacement crews were utilized to fill the duty pilot and technician slots. Additionally, the 27th T.C. Squadron newly arrived from Dunnellon, Florida, following a year's demonstration duty with the AAF School of Applied Tactics, completed the new Group's operating force.

Many of the oldest and most capable mechanics in the Air Force had long been assigned to the old 1st and 2nd Troop Carrier Squadrons. Both of these Squadrons had long creditable pre-war records and about 18 months of valuable theater experience. Consequently, the 315th Squadron began operations manned with several of these able veterans who had virtually brought the C-47 into the Air Corps. They were now assigned to put this foreign born and "bottom of the barrel" outfit "on the road."

Several of the 315th Squadron members were most familiar with con-



Credit: AIR FORCE PHOTO

A direct view from the rear of the C-47 shows the barrels of the mounted machine guns sticking out the sides of the fuselage.

ditions and problems unique to air operations in India. Since Group Headquarters was on the same base, it seemed natural for the 443rd to lean heavily upon this outfit for support. It was to the 315th T.C. Squadron's maintenance Shop that Colonel Farr instinctively took the fabrication job of arming the "Gooney," despite the fact that it was the plight of the day-flying 1st and the 2nd Squadrons that posed the original problem. The 315th was still wholly committed to the night-flying delivery of men, mules, medicine, ammo, food and fodder and evacuating wounded for the British West African Troop under Wingate, who successfully continued to interdict Jap lines of communication in the interior of Burma, between Mandalay and Myitkyina.

In order to check the progress of his fire power augmentation program, for the next week, each day after lunch, Colonel Farr and I would jeep our way to the Metal Work Hangar through the melee of the packing and loading activity required for the coming night's missions. Early, it became apparent to me that the Colonel had been giving this project some extra time. Instead of a single installation for which I had already lined up a Cal. .50 at Motor Pool Supply, I suddenly had to get a companion piece, complete with ammo belts, swivel pins and

ammo cans.

C-47 No. 315054 was the first ship cut from the herd to undergo the surgery that would transform this placid beast of burden into a deadly bird of prey. As originally conceived, a large aperture was cut out of the aft half of the double width cargo door from about waist high to slightly above eye level. A tripod of heavy angle iron was attachable by set screws to the floor and lower edge of the new aperture in the aircraft and provided a stable platform for a slotted frame into which neatly fitted the stem of the swivel pin mount of the gun. Thus the gunner standing securely inside the airplane with the gun barrel outside had a radius of action of approximately 160 degrees of transverse, about 80 degrees of elevation and a like amount of declination, minus of course the contour of the tail assembly and the wing about which there still was a lot of pilot head shaking.

The Colonel's extra duty on this project manifested itself in a similar lash up made by cutting a wider but similarly positioned aperture in the bulkhead directly across from the port side installation. A brace for the swivel pin was secured directly to the rib structure of the air frame. This gave an identical radius of action to the starboard side gunner with similar ominous restrictions. Endless discussions seemed to confirm the notion that maneuver of the ship could provide the two gunners with virtually unlimited area of fire coverage.

One hot humid afternoon with Major Earl Cummings in the left seat, Lt. Francis J. Sweeney as co-pilot, the Colonel and I, then a Captain, rose cautiously above the tea fields of the upper Surma River Valley to test fire the "Ugly Duckling" aloft.

Prior to take-off both the Colonel and I had test fired the guns from their new mounts into the high dirt banks of an unused revetment. He and his air frame structural advisors, from the Squadron Engineering Officer down through the ranks to even the curious and bewildered native tea patch laborers, expressed conviction that the modification would be airworthy. We anticipated no trouble from a construction standpoint.

Reaching cruising altitude, Colonel Farr told Cummings, over the intercom, to head for the "boondocks," meaning the large tract of teak studded jungle covering the low hills lying to the East of Sylhet, previously selected for this aerial test firing. Picking a location required considerable thought and terrain selection as native Indian villages could be situated almost anywhere. We wanted to discover the effectiveness of firing "air to ground." Consequently, it was necessary to pick a spot most unlikely to involve our friendly but ubiquitous hosts. Inquiry revealed that not even snakes would be encountered in that area, so it became the logical choice.

Enroute to the target area final check of the guns, the mounts, the ammo belts and even the two gunners, Colonel Farr and myself, revealed all to be in order and ready to go.

"Mac—you're the gunner," Charley said, "go ahead and fire." This was truly an unselfish and friendly act because the Colonel had doped out the deal, yet here he was according me the "honors." Without further ado, I pulled back the bolt arming the gun, pointed the barrel down to earth on the port side well back of the trailing edge of the wing, making sure lots of distance existed ahead of the tail surfaces, and pulled the trigger.

Five empty shell casings rattled to the smooth aluminum floor of the plane before I released. This was two more rounds than the school ap-

proved "burst" I had been taught to master the year before in gunnery school at Fort Meyers, Florida.

Colonel Farr then prepared to check out the gun on the starboard side. Encouraged by the favorable reaction experienced so far, he confidently and expertly proceeded to give his gun a thorough work out. Pilot to gunner communication reaffirmed that single gun firing had no recognizable effect on control of the ship's flight. And now for the big and final test. Would both guns in action develop any hazard?

It was decided to fire two short bursts and, if no difficulty was encountered, to fire "at will" until the ammo belts were used up. About 200 rounds remained in each.

"Ready, Mac? Fire!" came the Colonel's order and we each ran off two short bursts. "Still doing fine Colonel," Cummings reassured over the intercom. "Let 'er rip, Mac." And I did, but being awfully double careful to keep that distance between wing and tail piece neatly divided by my gun barrel. As the echoes from this final blast died away, the Colonel jubilantly announced, "Take her home, Earl, we have us a 'Fire Bird'."

"It doesn't matter about being born in a duck yard, as long as you are hatched from a Swan's egg," proved final and satisfying consolation to the Ugly Duckling. Colonel Charley Farr and all his lads, I think, that day gave the "Gooney" crews the "right to opinion, when sensible people are talking."

"So what" the hen might again petulantly inquire, "then what did you do?"

After our return to the Base fully satisfied that the sustained firing did no harm to the structure of the airframe, a plane from the 2nd T.C. Squadron was brought to Sylhet to be so modified. Shortly after its completion by the 315th Maintenance Shop it became apparent that such modification was a Depot chore, not that of a first and second echelon maintenance outfit.

Command Decision

Just about that time General Stratemeyer made one of his many visits to Sylhet. Because of the fluid command hassle that beset the China-Burma-India Theater (CBI) until the closing days of the war, the 443rd shuttled between being under China-Burma - India Theater - India - Burma Sector (CBI-IBS) directly or under the 10th Air Force, which, in turn, was under CBI-IBS. Consequently, when we were responsive directly to CBI, General "Strat" usually paid us a call. This was always a great boost for morale as "Strat" was genuinely well liked by all ranks. Our British comrades-in-arms at Sylhet joined us in this admiration for our boss. He was always one safe topic to explore when housekeeping squabbles wore the conversation thin with our British landlords.

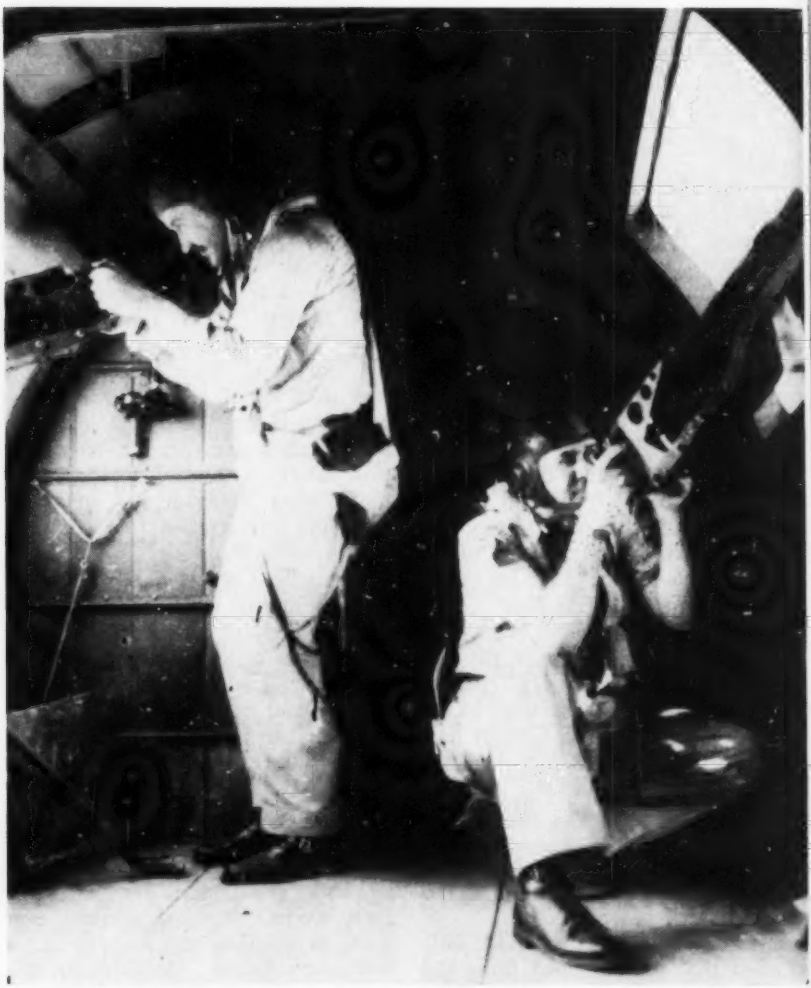
Naturally, Colonel Farr showed off his new answer for the Jap threat to our air dropping operation. General Stratemeyer endorsed the project with enthusiasm and the word got around that he had ordered the Air Service Command to so modify all 64 of our C-47's. Weeks passed without any action. Rumor had it that the Air Service Command found the job beyond their capability, as it would take 2,000 rivets per plane to do the job by their standards. We all knew there weren't that many rivets ever going to find their way to India in the foreseeable future. Undoubtedly, this tale is aprocophyl because shortly after "Strat" left our rain soaked area the Colonel told me I need not start

to work on a Group-wide gunnery training program just yet. To the best of my knowledge and inquiry, at the time and since, only two C-47's were so modified.

Firepower Demonstration

Both saw service as originally envisioned and proved the theorem prophetically enunciated by Colonel Farr.

Lack of any historical evidence in the records of the many sorties in which these two "gun" ships were used prompted this acocunt of their origin. The writer made several com-



The author (then Captain) John A. McCann was accorded the honor of being the first to test fire the improvised machine gun set-up on this unique C47. He is shown at the left. Col. Charles B. Farr is on the right.

bat sorties on the ship maintained by the 315th T.C. Squadron into areas where hostile ground fire during drops had been previously encountered. The Ugly Duckling seemed to provide relief from harassing fire during the recovery maneuver. On one such mission in which "054" was given a half load, "us gunners," (a big tall Texan EM, who was a whale of a shot, and I) were included in the crew. At the Drop Zone the other five cargo craft kept their eyes and the command set open to locate the origin of ground fire. When a clump of trees was isolated as the suspect location for a renewed attempt to criple our "Birds," both Tex and I gave it plenty of attention as we passed by the spot. No further enemy fire was reported then or subsequently. As Group Intelligence Officer, I maintained a personal vigil of subsequent pilot reports from that DZ, but the Ugly Duckling had apparently earned another "well done."

On 18 May 1944, I was aboard "054" with Tex and our two Cal. .50's which Captain Francis J. Sweeney, then C. O. of the 315th, piloted in the company of seven unarmed C-47's to Myitkyina. We had British Bofors antiaircraft guns aboard for delivery to the air strip which had been captured the night before by Merrill's Marauders. When we arrived in sight of the strip, we had a wonderful view of the counterattack being waged by the Japs against the Marauders who had been augmented by the 90 odd Bofors gun crewmen who were scheduled to rendezvous with our aircraft and accomplish the off-loading of their heavy and awkward guns. I had to really talk hard to dissuade Tex from joining the shooting, as he had the starboard position. He finally agreed that 1800 yards was beyond effective range.

Some two hours and forty minutes later, we left Myitkyina and the Bofors guns which the aircrews had to off-load, literally by hand. It was no surprise to hear the last three of our departing eight ship formation stridently declare "Mayday," clueing one and all that they were under hostile air attack. Sweeney had just topped the Northwest-Southeast ridge lying about 10 miles due west which separated the Kamaing Valley from the Myitkyina plains. As he dove the plane for the "deck" he alerted his two-gun stations. Wisely he announced that if we lost anything around here he wasn't hanging around to look for it. No Jap fighters came within range.

Just for the record and to add to the fickleness of fate, it was an "unarmed transport" that took off 50 seconds behind us which was credited with a confirmed *Zero*. By clever evasive tactics, the C-47 pilot suckered a hapless Jap pilot into that ridge we had just crossed.

For the curious, old "054" didn't wind up without a flourish at that. It was told around the C-47 campfires that she clobbered out in a blaze of glory up at Ledo. As the "Dakota" troubadors tell the tale, she came in for a landing at dusk one night through the mist that always plagued Ledo, only to run off the edge of the runway shortly after touchdown. The right tire blew and threw her into a violent ground loop which terminated when a brand new "plushed" B-25 offered immovable resistance. Nobody aboard "054" was hurt. But, the three-star Army general, for whom this B-25 with great labor had just been modified, heard with mixed emotions the "Swan Song" of our Ugly Duckling of Air Power.

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LIFELINE IN THE SKY, by Clayton Knight, New York: William Morrow and Company, 1957, $6.00.

Clayton Knight launched his interest in aviation as a pilot with the Royal Flying Corps in World War I. He was an Associated Press Correspondent in several theaters of operation and a combat historian for the U. S. Army Air Forces in World War II. He tells his story of the U. S. Military Air Transport Service from a sympathetic and non-critical viewpoint as he describes operations of the largest airline in the world and portrays with admiration the devoted efforts of its personnel around the world who sustain this "Lifeline in the Sky."

Lifeline in the Sky traces briefly and accurately the history, mission, and various tasks of this worldwide USAF managed activity. The reader is then treated to a station by station tour throughout the entire MATS system. Illustrative anecdotes and dramatic tales of derring-do by active and former MATS men give this travelogue added interest as do the author's pen and ink sketches and illustrations in water color.

This excellent overview of MATS complex activities, embracing personnel and cargo delivery by air, air rescue efforts, weather information service, photo mapping, and airways communications is never confused.

Experiences cited as illustrations are carefully calculated to offend neither the sensitivities of the most delicate nor draw critical attention to any MATS operational deed or philosophy. Anyone who has slept in the transient billets, eaten in "round the clock" messes or become snarled in the administrative red tape enforced by any international air travel finds the total goodness of Mr. Knight's description of MATS somewhat unrealistic.

Despite its acceptable accuracy, a vivid description of travel by air around the world, the personnel sketches and heroic episodes and well executed art work, this volume is not written for the veteran combat airman nor for the scholar of Air Power. Lack of objectivity and critical assessment will not satisfy the latter and its contents are too bland for the former. The easy style and attractive format of this interesting and, at times, lyrical account of one of the United States' finest military operations can, however, be recommended for informative reading to many others interested in global air travel and the other adventuresome aspects of MATS.

JOHN A. McCANN,
Colonel, USAF
Air War College

The Challenge of Air Power

At first novel, then startling, and now phenominal, the influence which air transportation has exerted and will play in man's conduct of peace and of war has erected crucial problems. Aviation has become a most powerful force underwriting the statecraft of nations in their relations with other nations. World conquest by a Napoleonic dictator of an ideology-mad nation no longer appears to be an idle fancy. The idea of a global federation of nations engaged in peaceful intercourse now appears to have some basis. Warring nations could bring down on one another mutually catastrophic destruction. Wholesale shattering of the major nations in the world by an accidental war also appears not impossible. All of these alternatives have been made technically possible by progress in aviation and in related scientific fields. . . .

Excerpts from Chapter XIII in forthcoming book, *The Impact of Air Power* by Eugene M. Emme, to be published by D. Van Nostrand Co., Inc., Princeton, N. J.

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How Aircraft Brakes Got That Way

By HAROLD R. HARRIS, *Brig. Gen. (Ret)*

In the early 1920s Donald Douglas built, under contract for the U. S. Navy, some single engined torpedo planes. These were designed somewhat like the World Cruiser, except that there was more wing area and a bigger fuselage. There was a further exception, and this led to the installation of brakes on modern airplanes.

Even though some of the airplanes of the early 1900s were equipped with wheel brakes, it was found that the low landing speed, the drag of the high angle of attack in the tail down landing position, and the drag of the tail skid, added up to enough braking power to eliminate brakes. Also, after the front skids were removed from early airplanes, designers were afraid that wheel brakes would throw the airplane over on its nose if too rapidly applied, since the landing wheels were fairly close to the center of gravity of the plane. Consequently, most of us who were actively flying in World War I and the early 20s had never seen an airplane equipped with brakes.

By late 1924 all land planes were equipped with swiveling tail skids which facilitated the turning of the airplane on the ground for taxiing purposes.

At this time the Engineering Division of the Air Corps, at McCook Field, was responsible for making drop tests of all parachutes before they were issued for service. These were drop tested by strapping the parachutes on dummies of the approximate size, shape and weight of a person; the dummy, plus parachute, was carried aloft by the airplane and dropped with a static line operating the ripcord. The only planes that we had for these tests were DH-4s, which would carry two parachute units at a time to be test-dropped. This was not as efficient as we felt it should be and, consequently, we borrowed from the Navy one of their Douglas torpedo planes so that we could carry four parachute units per flight. This Navy plane proved to be the most successful for this work, except that a man had to be stationed at the end of the landing run to hold the wing so the plane could pivot and taxi back for another load.

After some days of this waste of manpower I decided that if we could put a stick of some sort on the landing gear, just above each landing wheel, with a suitable manual linkage into the cockpit, a pilot could pull the stick down on to the top of the tire on the inside of the turn, thus effectively developing enough drag on that wheel to assist in the turn, and eliminating the necessity of stationing a man in the field to hold back the wing to accomplish the turn.

The application proved so successful for both taxiing and shortening the landing run, that brakes have been standard equipment on aircraft ever since.

NEWS ITEMS

Rockets, Missiles and Air Power:

To the editors of *The Air Power Historian*, as we trust most of our readers will concur, "Air Power" means the use of air vehicles as a weapon or instrument of national policy for exerting influence in war as well as in peace. Its future importance seems assured. While the frontier of outer space has been penetrated by the latest generation of air vehicles, man must always live in an earth-like atmosphere. Most of us will continue to live in the pressurized oxygen-laden envelope of air near the surface of the earth. But our future security and prosperity will be increasingly animated by the rising capabilities of vehicles exploiting outer space. Such was always in the nature of air power.

The history of air power can neither be exclusively the story of manned air vehicles nor only the significance of the influence of balloons, dirigibles, and airplanes upon the affairs of mankind. Air power cannot be married to jet airplanes anymore than the prominance of sea power was confined to sail or steam propelled ships. Sometimes rather queer terms have crept into the language of airmen, terms such as "Jetomic Age," "supersonic strategy," and the like. Now the term "space power" is being given great currency in the public speech, thanks to the Russian Sputnik and Muttnik. But if anything appears inevitable for the future it is that change in technology and the manner of its influence upon international relations is inevitable. Particularly will this be so with regard to the role of air forces in future affairs.

Fortunately, the editors were able to get Mr. Trevor Gardner, former Assistant Secretary of the Air Force, to write our lead article in this issue. Readers of *The Air Power Historian* can rest assured that its pages will include historical consideration of missiles and rockets in future issues also.

Airpower Book Club:

The long awaited *Airpower Book Club* has been officially launched. Sponsored by the Air Force Association, the *Airpower Book Club* aims to provide the best in air literature at the lowest possible prices to its members. An annual subscription of $15.00 brings a member four books with a guaranteed minimum retail value of $25.00 plus a premium book upon joining. A member will also receive a quarterly publication, to be called "Airman's Bookshelf," which will review all new and pertinent air books. Additional books can be purchased by members at a ten percent discount.

The initial premium book for joining the *Airpower Book Club* is the hard-back version of the Golden Anniversary issue of *Air Force Magazine* with added material, entitled *A History of the United States Air Force* (Princeton: D. Van Nostrand, 1957, $6.75). The first selection of the *Airpower* Book Club is the classic biography of Billy Mitchell, entitled *Mitchell: Pioneer of Air Power* (New York: Duell, Sloan and Pearce, 1957, $6.00). This is the authorized biography by Isaac Don Levine.

Readers of *The Air Power Historian* should find the *Airpower Book Club* a very worthy proposition. The editors wish the sponsors of the *Airpower Book Club* a smooth takeoff and a successful flight. A special commendation should be given Captain James F. Sunderman, USAF, for this and other accomplishments in getting the literature of the air established in the American publishing world.

The present articles by Maj. deSeversky General White and Dr. Strughold likewise we feel, will assist our readers to a better understanding and approach to the problems of missiles and "space power."

New Jet Records:

General Curtis E. LeMay, Vice Chief of Staff USAF, established a new world's record on 12 November 1957, by piloting a KC-135 jet tanker a distance of 6,350 miles without refueling. The previous jet record for distance in a straight line without refueling was made in 1955 by Elisabeth Boselli of France when she flew from Creil, France to Agadir in French Morocco, a distance of 1,448 miles. General LeMay and his crew of 28 flew from Westover AFB to Buenos Aires, Argentina. Commented the *New York Times* editorially on November 13th: "This flight gives an effective answer to those who would sing a swan song for the manned intercontinental air force, and for this reassuring demonstration General LeMay deserves the plaudits of the nation and of the free world."

A week later a flight of three B-66 jet bombers flew non-stop 8,000 miles from George AFB, California, to the Philippines with one refueling. This flight took 17 hours. This was the first of a series of flights to show that Tactical Air Command can deliver a tactical striking force anywhere in the world to meet "brush fire" emergencies. While there have been many other noteworthy flights demonstrating the global legs and striking range of American bombers during the past several months, the two reviewed above seemed to deserve additional mention in the pages of *The Air Power Historian.*

Footnote on the "Ostfriesland":

The following item is quoted from an Associated Press article: "Bayonne, N.J., Nov. 9 [1957]—The 57,000-ton *Wisconsin,* Navy battleship which saw heavy action in both World War II and the Korean War, berthed here yesterday to end her career.

"Moth-balling the vessel is part of the Navy's present emphasis to atomic-powered armament. Already at rest are such battleships as the *Iowa, New Jersey* and *Missouri,* which served with the *Wisconsin.*

"The *Wisconsin's* retirement leaves the Navy without an active Man O' War for the first time in 62 years."

Speaking Engagements:

For the past several years, the Executive Director of THE AIR FORCE HISTORICAL FOUNDATION has traveled practically from one end of this land to the other delivering speeches and propounding on air power and the use of air power. Enjoying the prerogative of speaking as the Executive Director of THE FOUNDATION, Maj. Gen. Orvil A. Anderson (Ret.) has used the opportunity of these speaking occasions to help attract new memberships to our rosters. While the membership rolls continue to grow daily, the rate of growth is not yet what is desired by the Board of Trustees, and is not yet sufficient to aid in the production of a larger and better publication.

Since last July, Gen. Anderson has spoken to several groups of Squadron Officer School students; to the student body of Troy State Teachers College, Troy, Alabama; the Kiwanis and Optimists Clubs of Phoenix, Arizona; South Texas Retired Air Force Officers Association, San Antonio, Texas; Aviators Post of the American Legion of New York City; the officers of Reese Air Force Base, Texas and the Social-Scientific Group of the Maxwell AFB Hospital staff. He is scheduled to speak at the Military Order of World Wars in Daytona Beach in January. Units, groups, and organizations, social or scientific, are encouraged to write or call the Executive Director to make arrangements for a speaking engagement.

Individual members of THE AIR FORCE HISTORICAL FOUNDATION, who are interested in promoting THE FOUNDATION, and its aims, are likewise urged to solicit occasions for meetings, whether with military or civilian groups or combination of both.

de Seversky on "Person to Person":

Many members of the AFHF were undoubtedly pleased at seeing and hearing Major Alexander P. deSeversky on Edward R. Murrow's CBS TV program, "Person to Person," on the night of 8 November 1957. Here are several of his timely comments:

MURROW: I am sure you have been doing a little studying up on missiles.

SEVERSKY: I certainly have done that, because missiles are just an extension of aerodynamics . . . .

MURROW: Major, I believe that you have probably logged as many hours on the lecture platform as behind the controls of an airplane, haven't you?

SEVERSKY: Yes, I — particularly during the World War II, I tried to awaken the American people to the importance of air power. And it is still important today: whether in fighting with missiles or planes, the command of the air and the space above is our first objective that we ought to achieve, and we ought to attune our Armed Forces to achieve this command of air and space above before we can use any forces on land or sea.

MURROW: Well, which do you find more satisfying, talking or flying?

SEVERSKY: Flying, of course. Flying, and engineering, and building my business— but I find myself talking.

MURROW: Well, that's part of the business, too, and part of the business of education, isn't it?

SEVERSKY: Well, that's true. I feel really very seriously that we must adopt an entirely new philosophy in national defense. We must reorganize our national defense, we must remove the curse of the outmoded strategy of balanced forces and free our American genius from the confines of this obsolete concept.

MURROW: Would you be in favor of a single defense unit, not Air Force, Navy and Army?

SEVERSKY: Definitely so, for the simple reason that in addition to the Air Force, the Navy is already 90% air force. It is trying to project its military power through the air and space above. And so does the Army. It wants also to project its power through the air and space above. So therefore we must now integrate all these forces into one military force of the United States. The time has come, and the sooner we do this, we guarantee that our country is not going to be destroyed.

Reunion — 148th Aero Squadron

Recently, on 14, 15, and 16 of September, 1957, about 100 officers, men and their wives converged at Myrtle Beach, S. C., fo the first reunion of the 148th Aero Squadro in about 40 years. The reunion was larg ly promoted under the influence of Ellio W. Springs, one of the leading aces World War I, and a member of the 148t

The 148th American, as it was affectio ately known, was activated in 1917; it r ceived a large part of its training and co bat experience under the British, and serv in France with the British Expeditiona Force. The squadron has a record of 4 German planes, crashed or brought down flames, and 19 which were knocked out control. This feat was accomplished in period of less than four months, and duri this tour only four of their officers we killed in combat, four were brought do behind enemy lines and taken prisoners a three were wounded.

The reunion was presided over by Cap Mort. Newhall (Ret.) of Greenwood, Va who was one of the Squadron Commande in France. The highest ranking member the 148th in attendance was Maj. Ge Clayton Bissell, who retired in 1948.

The yearlong task of locating and co responding with former members of th 148th was the lot of Mrs. and Capt. Ne Goen (Ret.), of Melbourne, Fla.

At the concluding session of the reunio all members present voted to hold anothe reunion in five years.

Notes on Our Cover — The Bug

Developed twenty-five years before Hi ler's V-1, the U. S. Air Service "Bug" wa the first American pilotless aircraft built and probably the world's first pilotless air craft. It appeared too late to participat in World War I, however. Work started on the project in September 1916 at th old South Field in Dayton, Ohio, by th Dayton Wright Testing Company. En gineers of the project were Mr. C. H. Will and Mr. Jack Beebe, while Dr. Elmer Am brose Sperry worked on the control mecha ism. The Bug was constructed of wood reinforced paper maché and was powered by a 40 horsepower engine. It carried about 300 pounds of explosives to a rang of about 50 miles, and the explosives were

similar to those used in the warheads of the V-1 and the V-2.

Gen. Henry "Hap" Arnold related several interesting details about the Bug in his book, *Global Mission*. Developed under the watchful eye of Charles Kettering, the Bug was tested in the Fall of 1917. According to Arnold: "Our first tests being highly successful, we decided to demonstrate the Bug to top Washington brass, and invited them to Dayton, Ohio. With the care that goes with such occasions, it was decided that only enough gasoline would be put in the tank to allow the Bug to leave the track and make a straightway flight of two or three hundred yards at most. Unfortunately, not even Kettering realized how litle gasoline the Bug needed to operate. After a balky start before the distinguished assemblage, it took off abrutly, but instead of maintaining horizontal flight, it started to climb. At about six or eight hundred feet, as if possessed by the devil, it turned over, made Immelmann turns, and seeming to spot the group of brass hats below dived on them, scattering them in all directions. This was repeated several times before the Bug finally crashed without casualties . . . .

"A second show was set up. This time we believed the Bug would fly straight for a mile or so at about 50 miles per hour, so we loaded the high ranking visitors into automobiles to follow it and be present when it crashed. Everything looked perfect for the test. The efficiency of the flying bomb was now a certainty. Our one fear was that information about it might leak out to the Germans. Again it got away. Instead of flying straight it made a circle around the city of Dayton . . . . In the vicinity where we thought we had seen it come down, we came across some excited farmers. 'Did you see an airplane crash over here?' we asked. One farmer said, 'Right over there! But strange thing, there's no trace of the pilot!' Colonel B. J. Arnold, the Army officer in charge of the project, remembered quickly that we had a flying officer in a leather coat and goggles in the car. 'Here's the pilot,' he said. 'He jumped out in his parachute back a piece. Let's go back and pick up that wreck.' Our secret was secure."

Gen. Arnold also related that an improved Bug was developed and flight tested in December 1941. With a range of about 200 miles and a bomb load of 800 pounds, it was considered that 500 of them could be employed for the price of one B-17 with a bomb load of 6,000 pounds. Because of a lack of accuracy against targets in Western Europe, the 1941 version of the Bug was dropped as a feasible weapon.

—Quotations taken from H. H. Arnold's *Global Mission*, New York, Harper Brothers, 1949.

Billy Mitchell Memorial

On Dec. 17, 1957, on the 54th anniversary date of powered flight, a memorial tribute was finally paid to one of the outstanding luminaries of air power, General William Mitchell, when a slightly larger than life size statue of him was unveiled in Washington, D. C. The bronze statue, located at Ninth Street and Jefferson Drive, S. W., The Mall, was unveiled by William Mitchell Jr. at approximately 4:30 pm.

The replica is a gift of the late George Stephenson and was sculptured by Bruce Moore. It represents the culmination of a long and arduous campaign on the part of many air enthusiasts to honor the once strong proponent of air power and one of air's outstanding prophets.

Dr. Leonard Carmichael, Secretary of the Smithsonian Institute, gave the introductory remarks about the statue and introduced the guests. General Carl Spaatz, who served under Mitchell in the early turbulent twenties, was the principal speaker and spoke on "General William Mitchell, Pioneer of Airpower."

Wright Brothers Memorial Trophy:

Senator Stuart Symington was recently awarded the annual Wright Brothers Memorial Trophy for his "distinguished career of public service in the field of aviation." Each year the National Aeronautic Association honors a distinguished American. There is no requirement to recount here the contribution of Senator Symington to the cause of American air power before and since being the first Secretary of the Air Force (1947-50).

LETTERS TO EDITOR . . .

With this issue of *The Air Power Historian,* the editors are happy to institute a section offering diverse or confirming opinions expressed by our readers. It is our policy to consider only signed letters. We can neither guarantee publication of letters received nor that we can reprint them in full. Our purpose is to stimulate thought and to promote getting the historical record complete or objectively considered.

Re: Avenging Call

Dear Sir:

I keep reading in the *Air Power Historian* about the Doolittle Raiders and it seems to me that this single raid has been singled out for too much discussion — to the neglect of articles and comments on other important missions of World War II.

Why can't we have some articles or comments on some of the other historic raids, like the Schweinfurt and Ploesti raids, and on such campaigns as the B-29 Mining Campaign against Japanese submarines.

Sincerely,

BRUCE G. SUNDLUN.

Dear Sir:

I refer to Jack Sims' account of the Tokyo Raid in the October issue of *The Air Power Historian* and frankly admit it to be a well told tale. At the risk of being trite, however, it seems I have been offered a serving of this same story at least once a year for the past ten years. No matter how you re-hash it, my appetite for the details of this particular operation have been gratified beyond desire. I wonder how many other readers had the same reactions.

I feel sure there are many other exploits of the Air Force which were just as exciting, just as intrepid — and considerably more successful than the Tokyo Raid; actions whose detailed stories have been told far less frequently or not at all. How about some of the significant but lesser known European raids, or some of the early operations in the South Pacific, Alaska and Asia? Certainly a selection of other less popular accounts could be equally as significant historically and would provide a much greater service to your subscribers.

A pox on glamor stories — let's have more of men and machines and organizations and concepts — yea, even unto the fables of Sam and Joe.

Sincerely,

R. L. MICHAELIS,
Colonel, USAF.

Plaudits

Dear Sir:

Just a note to say I have enjoyed *The Historian* very much. I would like to add my "Amen" to the present crusade being waged by the members of THE FOUNDATION to awaken the people to the facts. You may rest assured I let no opportunity pass to spread the doctrine for which we all stand.

Sincerely,

FRED E. THOMPSON,
Capt. USAF
Duncanville, Texas

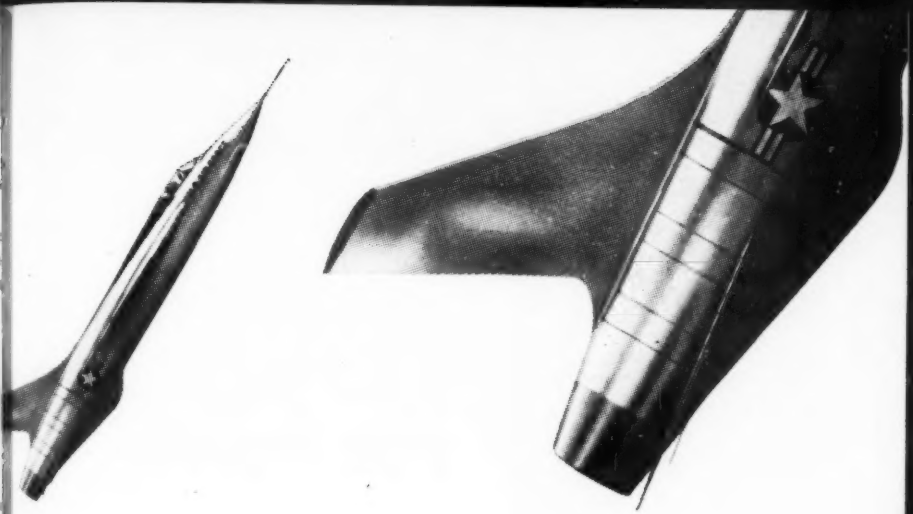
Dear Sir:

I would like to take this opportunity to express my feelings about your publication. I have been a member of THE FOUNDATION since its beginning and have received all issues of the quarterly publication. I have seen it grow to be a splendid document and have enjoyed every issue. I eagerly look forward to receiving it each quarter. The articles are most interesting and have given me a much better understanding of the development of our Nation's air arm. Please accept, and express to all those concerned, my congratulations on accomplishing a splendid job.

Sincerely,

RICHARD RAYMOND,
Major USAF
Shaw Air Force Base, S. C.

Editor's Note: In future issues we hope to have substantive articles on the Ploesti, Schweinfurt, and other lesser known air operations in World War II and Korea.



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Maj. Gen. David H. Baker, President of Capital Airlines and until recently the Director of Procurement and Production, Air Materiel Command, stated "It is becoming increasingly evident that in the selection of weapons or components in a competitive situation, the blue ribbon will go to the company which has recognized **reliability as the prime requisite** in his product."

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NEW HORIZONS ARE AHEAD FOR MANNED AIRCRAFT

No matter how far man's technical ability may soar, he himself has one faculty that no machine will ever duplicate—the ability to make a command decision... to meet an emergency or make the most of an opportunity.

This unique power—implemented by higher performance airplanes—may very well make the manned aircraft of the future our most versatile, flexible, accurate weapon.

Though the new strategic missiles will be mighty buttresses to our nation's defense, we also need *manned* weapon systems for *maximum* security.

These new aircraft will fly so fast, so high, so far that they will be the forerunners of manned spacecraft. They will be able to bomb any target on earth with pinpoint precision—or to launch a missile from the edge of space.

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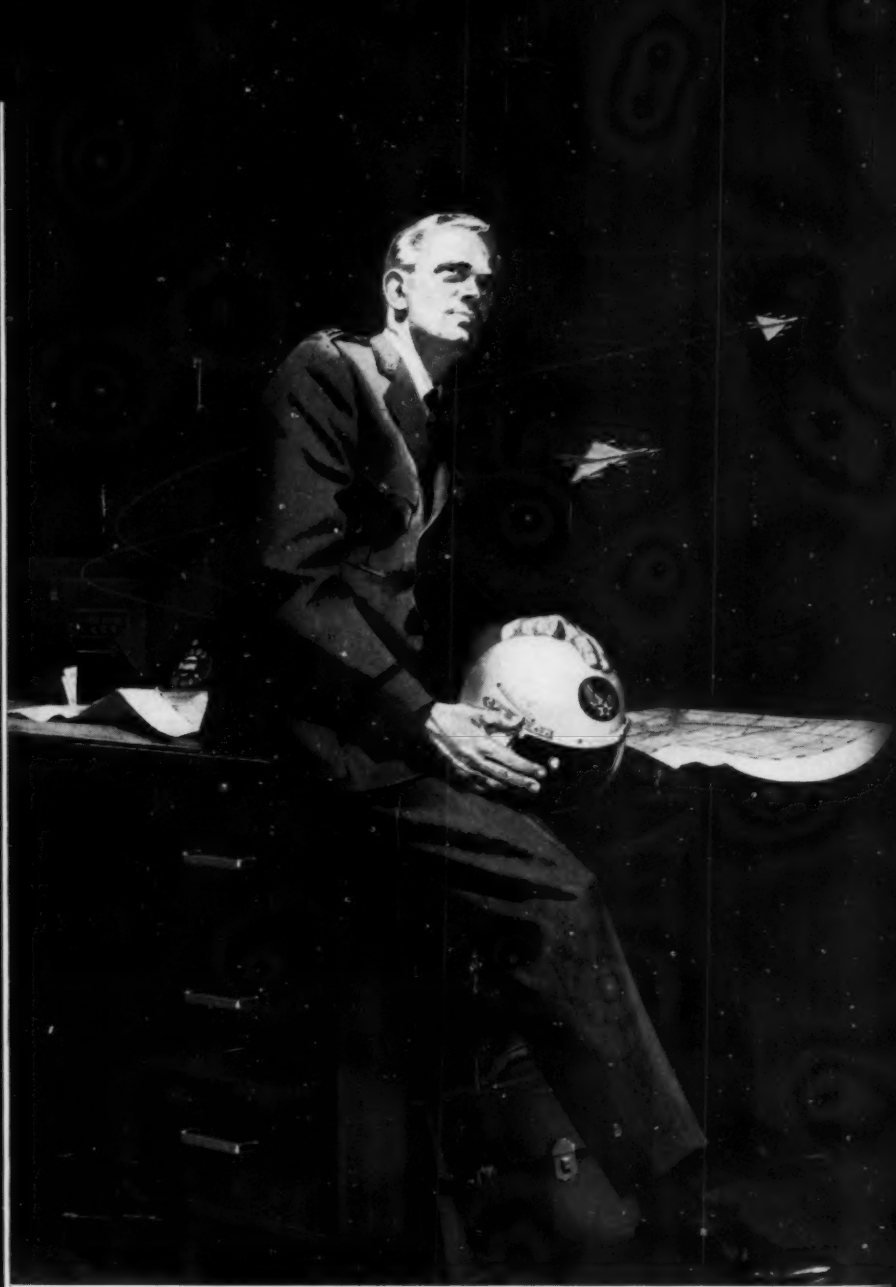

Peace is his profession

For more than a decade the officers and airmen of the United States Air Force *Strategic Air Command* have waged *peace* with all the vigor and resolution the military once gave only to war. The survival of our civilization in which freedom of religion, education, art, science and government flourishes, depends today upon the men who are practicing *peace* as a *full-time* profession. In this restless world these professional men are actively dedicated to our way of life!

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